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CONTENTS.

Editorial 51
Radiating Surfaces of Lamp Filaments, by John W. Howell 53
On the Influence of Radiating Power Upon the Efficiency of a Lamp Filament, by E. L. Nichols 53
Discharging of Electrified Bodies by Röntgen Rays 53
Fort Wayne-Siemens & Halske Consolidation 53
Direct Current from Alternating, by Albert G. Davis 54
The Electrical Equipment of the Hotel Manhattan 55
The Interests of the Public in the Telephone Situation—II., by F. W. Dunbar 58
Principles of Electrical Distribution—IV., by Francis B. Crocker 60
The Use of Storage Batteries in Railway Work, by Wm. Baxter, Jr. 62
Decorative Lighting, by E. J. Jenness 64
The Efficiency of Water Wheels, by F. M. F. Cazin 66
Medicinal Properties of Röntgen Rays, by William G. Caffrey and Nathaniel E. Wilson 67
E. M. F. Regulation of Electric Motors, by R. M. Hunter, and H. Ward Leonard 67
The Effect of Pressure Upon the Temperature of the Arc 68
Digest of Current Electrical Articles, compiled by Carl Hering 69
New Electric Railway Line in Pittsburg 72
New Röntgen-Ray Apparatus 73
Santa Claus Visits Ottawa in an Electric Car 73
Die Head 74
Large and Elegant Plant for the Waldorf Hotel, New York City 74
Cedar Poles for Electrical Uses 74
Automatic Illumination Cylinder 73
Electric Switching Locomotive 75
Departments:
Financial Intelligence 76
Special Correspondence 76
General News 78
Legal Notes 79
Obituary Notes 80
Trade and Industrial Notes 80
Business Notices 80
Illustrated Record of Electrical Patents 80

PHYSIOLOGICAL PROPERTIES OF RÖNTGEN RAYS.

It was reported as early as May last that Prof. Brandes, of the University of Halle, had demonstrated that the eye, after the lens is removed, is capable of perceiving light effects when subjected to the action of Röntgen rays. It required, however, the aid of a sensational press to bring the question into prominence so that for some two months past the minds of many have been imbued with the fallacious idea that with the aid of Röntgen rays the blind could be made to see. The question has, however, its scientific value inasmuch as the results show that in all probability there exists between the limits of the ordinary visual spectrum and Röntgen rays a type of vibration, perhaps similar to Becquerel rays, capable of affecting the eye of a blind person, but for some reason not the normal eye, a fact possibly explained by considering the former the more sensitive. During the past Summer it was reported that Röntgen rays produced a deleterious effect upon the skin similar to sunburn, which has been attributed to various causes such as ozone, nitrous oxides, electrification, etc., but it seems to be quite generally agreed that it is directly due to either a very low order of Röntgen rays, or perhaps more plausibly explained as due to the direct action of the ultra-violet light of the vacuum tube.

The scope of surgical diagnosis by means of Röntgen rays is apparently attaining possibilities little conceived of but a few months ago by the most imaginative followers and investigators in this line. Medical practitioners, as a rule, have refrained from experimenting with Röntgen rays for the purpose of determining the possibilities which they offer. This fact may be attributed to two causes, one being a lack of familiarity with electrical apparatus and manipulation, and the other the tendency to avoid all appearance of quackery. Those more skilled from an electrical standpoint have been, as a rule, equally unskilled from a medical point of view.

In a communication on "Röntgen Rays as a Medical Aid," published in our last issue, Prof. Stine has pointed out that a more accurate knowledge of the condition of a patient may be obtained by diagnosticating with the aid of Röntgen rays than by any other method. These results have been confirmed by others who have worked in this line and who have pointed out that opacity to Röntgen rays apparently due to a condensation of the pulmonary tissue was confirmed by auscultation and percussion, and that pulmonary lesions and diseases of the thorax may be reliably diagnosed.

Prof. Stine finds that the diagnostic purposes of Röntgen rays do not depend on their penetrative power but on their property of differential absorption, doubtless primarily due to their non-homogeneous nature. This property he finds offers most reliable means of diagnosticating inasmuch as it permits of carefully watching the effects of treatment. Any beneficial effects which may be produced he believes are not to be attributed to any chemical action, but are rather tonic in their nature, and yet differ from the deleterious skin effects which have been found to exist.

In a communication which appears elsewhere in this issue more remarkable cures with the aid of Röntgen-rays are reported, so remarkable, in fact, that one is inclined to place the statements made concerning them with those setting forth the rejuvenating properties which are supposed to exist in electric hair brushes, electric belts and numerous other so-called electrical appliances. Inasmuch, however, as Prof. Stine has alluded to the fact that he has observed

similar beneficial effects in a case of tuberculosis, it seems possible that there may be something worthy of consideration in the statements which it contains. We regret that the communication is couched in terms such as to make it savor strongly of "fakeism."

THE TELEPHONE SITUATION.

In an article on "The Interests of the Public in the Telephone Situation," concluded in this issue, Mr. Dunbar has pointed out many facts which have a most important bearing upon the future status of the telephone industry in this country. It is only by a most thorough and careful study of the many phases which the subject presents that the intricate questions involved can be comprehensively formulated. Mr. Dunbar has treated the subject mainly from the standpoint of commercial operation, but has referred also to the legal situation. Notwithstanding the fact that at a comparatively early period in telephone history, Van Rysselberghe secured a fundamental patent on the simultaneous transmission of telephone and telegraph currents, which patent has recently expired, few outside of the inner circles have realized the extensive application to which this method has been put. Another point which Mr. Dunbar raises is the fact that the development of long-distance telephony has been brought about by expensive line-construction rather than by the introduction of devices which, if reliable, would affect an immense saving in construction. Inasmuch as long-distance telephony is not limited at present by a want of quality in the transmitted speech, but rather by a want of volume, it is apparent that its difficulties may be overcome either by the introduction of repeaters or relays, or by methods of neutralizing the effects of capacity and self-induction. Mr. Dunbar points out that a successful repeating device would effect a saving of $75,000 on a single circuit between New York and Chicago, a fact of public interest, inasmuch as the public is required to pay for the additional expense which present methods involve.

THE BERLINER PATENT.

In view of the fact that the public is now anxiously awaiting the decision of the Supreme Court on the validity of the Berliner microphone patent of 1891, the legal aspect of the telephone situation holds at present a most prominent position, and a brief review may prove not untimely. Although it is quite generally conceded that the American Bell Telephone Company, in the recent hearing before the Supreme Court of the United States, made a strong argument in support of the validity of the Berliner patent, and although the counsel for the United States labored under the disadvantage of a more limited knowledge than that possessed by the counsel for the Bell Telephone Company concerning the history and method of operation of the Berliner invention, as well as concerning the true relation of this invention to the state of the prior art, yet a review of the testimony and arguments submitted by both sides discloses several points set up by the Government against the validity of the patents which do not seem to be fully met by the arguments of the American Bell Telephone Company. Thus, aside from the question as to whether the Bell Telephone Company did or did not connive with the Patent Office officials to secure the long delay in the issue of the patent, it appears that the granting of a broad method patent for the construction of the microphone more than 15 years after the patent grant to Bell, covering the method of the microphone, cannot be looked upon otherwise than as a wrong to the public, and undoubtedly is contrary to the spirit of our patent laws, for, were it otherwise it would appear possible for a patentee to prolong his monopoly of a certain invention under patent protection for an indefinite length of time. Thus, in the case in hand, assume that the conception of the method of transmitting speech by means of undulatory currents similar in form to sound-waves, the adaptation of mechanical apparatus in conjunction with this method and the discovery of the superior microphonic properties of carbon were three distinct inventions, each and all necessary to the successful transmission of speech. If these inventions were made or controlled by one party and applications were duly filed within the time limit of prior use it would be possible, by delaying the issue of the patent, for the second invention until the eve of the expiration of the patent for the first, and delaying the issue of the third until the eve of the expiration of the second, by means of interference proceedings, to obtain an exclusive patent protection upon the telephone for a period of more than 50 years. In the case under consideration it appears that the fundamental carbon patent expired through foreign limitation before its issue, on account of a British patent which Edison unfortunately took out. The process patent of Berliner, however, was duly issued just previous to the expiration of Bell's fundamental method patent, and has about 12 years yet to run.

It appears that a patent was granted to Berliner in 1880 for an apparatus identical with the apparatus of the 1891 patent (the patent in suit), and to be used in combination both as a receiver and transmitter. If, on the expiration of this 1880 patent, the combination of this patent, including the transmitter of the 1891 patent, be not free, then there exists a case of double patenting to the same inventor, and the latter patent would appear to be void. It has been assumed by the counsel of the American Bell Telephone Company that the liquid transmitter invented and operated by Bell in 1876 acts on a different principle from that of the microphone transmitter of Berliner. This point was carefully considered by Judge Aldrich, in which he has shown that both forms of transmitters depend for their variation in resistance upon the same principle, *i. e.*, on a variation in the number of molecules in contact at the point of variable resistance. If this view be accepted it would appear that Bell's transmitter should be recognized as the first microphone, and that Berliner was not entitled to a broad patent covering all forms of microphones, but entitled only to the particular form of transmitter disclosed in his patent. It is also questionable whether Berliner really invented the constant-contact transmitter or microphone described in his patent, inasmuch as he states in his original application of June 4, 1877, that the constant-contact transmitter therein described will transmit musical sounds, but is not adapted for the transmission of speech. To transmit speech he employed a double-contact make-and-break transmitter. A reasonable explanation of his failure to transmit speech by constant contact lies in the fact that at that time he used a very inferior receiver, it being identical in construction with his transmitter.

If Berliner made the discovery that his constant-contact transmitter would transmit speech subsequent to June 4, 1877, the date of his application, he apparently was not entitled to the patent granted him, for meanwhile Edison had disclosed his constant-contact carbon telephone. It appears that the primary examiners in the Patent Office, after the various amendments and substitutions had been made in the Berliner application, decided that the constant-contact transmitter claimed by Berliner was new and not disclosed in the application as filed. The decision of these examiners was reversed by the Commissioner on appeal by the American Bell Telephone Company, an appeal which was made direct to the Commissioner instead of through the Board of Examiners-in-Chief as required by the statutes. The American Bell Telephone Company has argued that many of these points cannot be properly considered by the Supreme Court as they were not argued in the Court of Appeals, but it is not improbable that our Supreme Court of Justice, realizing the difficulties under which the Government counsel has labored, and recognizing the interests of the public, which are at stake, will consider all the evidence submitted and render a decision upon the justice and equity of the case.

Radiating Surfaces of Lamp Filaments.

BY JOHN W. HOWELL.

The criticism which London *Lightning* makes upon Mr. Marsh's ideal filament,[1] which radiates no light, is perfectly proper; but their "Reviewer of Reviews" gets rather involved in his own argument by forgetting that the best filament is the one which at a given temperature yields the greatest amount of light for the energy expended, or which for a given ratio of light produced to energy expended operates at the lowest temperature. These conditions depend very much upon the radiating power of the surface.

Consider a filament operated by 50 watts and giving 16 candles. Keeping the supply of energy the same, if we make the surface a poorer radiator the temperature of the filament must rise to radiate the energy supplied, and being hotter it will yield more light, although the energy supplied remains the same.

If the filament with its original surface be supplied with more energy until its light is increased to the same amount, its efficiency will then be less than the efficiency of the poorer radiator, because the amount of energy has been increased.

If the energy be still more increased, the efficiency of the good radiator can be made equal to the efficiency of the poorer radiator but its temperature will then be much higher, its deterioration much more rapid and its life shorter.

These considerations demonstrate that the poorer the radiating power of a filament the less the energy needed to produce a given amount of light, and the lower the temperature of the filament at any given efficiency.

The base of lamp filaments is amorphous carbon, which is black and smooth. This is surfaced with graphitic carbon, which is gray and not always as smooth as the base. The radiating powers of these two kinds of carbon are about as four to three, the amorphous carbon being four. A black unsurfaced filament, which with a given amount of energy, say 50 watts, will yield a given amount of light, can be given a thin coating of graphitic carbon and will then yield considerably more light with the same amount of energy supplied, 50 watts. This coating will increase the surface of the filament, which makes the result all the more remarkable.

This change is not due to smoothness, for the base is as smooth as the graphitic surface, but the improvement is due to the poorer radiating power of the graphitic surface.

Lightning's reviewer says: "Granted that a smooth surface radiates less heat it also radiates less light, and therefore the temperature must be raised to get equal candle-power." I think this is a wrong conclusion. I grant that at the same temperature the poorer radiator will radiate less heat, but I do not conclude that it will radiate less light, for while the total radiation is less, the proportion which is light is greater, and while I am not sure that the light will be fully equal to the light from the better radiator, I believe it will be equal.

This opinion is based on observations made upon lamp filaments of various kinds, having very different radiating powers, but as I have not been able to measure their temperatures I state this as my opinion only.

The fact that a filament with a poorer radiating surface gives more light per unit of energy expended, at a given temperature, or gives the same ratio of light to energy at a lower temperature, can be easily demonstrated, but whether the different filaments, at the same temperature, give the same light per unit of surface is not so easily determined. I hope Dr. Nichols will enlighten us on this subject.

On the Influence of Radiating Power Upon the Efficiency of a Lamp Filament.

To the Editor of the Electrical World:

SIR:—The superiority of lamp filaments which have the bright surface obtained by treatment over filaments with the black surface of untreated carbon is unquestionably due in great part to their lower radiating power. When we develop a given amount of energy in a lamp filament its usefulness as a light-giving machine depends upon the temperature which it attains. A filament capable of getting rid of its energy so freely that its final temperature lay below the red heat would be worthless. The lower the radiating power the higher will be the final temperature reached by the filament when a given amount of energy is expended upon it. With rising temperature the crest of the curve which expresses the law of radiation as a function of the wave lengths moves toward the shorter wave lengths of the spectrum, and in this way a larger percentage of the total radiation is brought to lie within the particular region to which the light-giving rays of the visible spectrum belong.

That gray filaments are indeed poorer radiators than black ones has been shown by H. S. Weber[2]. There were found for black filaments radiation coefficients lying between 0.0000169 and 0.0000174, while 30 gray filaments gave values between 0.0000127 and 0.0000132. That filaments with a bright surface are really more efficient than those which possess the natural black surface of the untreated carbon there is also abundant evidence. (See, for example, *Physical Review*, Vol. 2, page 260).

I believe it to be true also that the law of radiation of treated filaments differs from that of untreated carbon. Measurements of the curves of distribution of energy in the infra-red spectra of the two at various temperatures indicates that the curve in the case of the gray carbon possesses a broader crest at the maximum and that the maximum for a given temperature lies at a shorter wave-length than is the case with the untreated carbon. The result of this peculiarity in the law of radiation of gray carbon is to furnish a larger proportion of light-giving rays at a given temperature, and thus to increase the radiant efficiency of the lamp. The evidence upon which I base this statement may be found in the article just quoted.

ITHACA, N. Y. EDW. L. NICHOLS.

[1] THE ELECTRICAL WORLD, Nov. 21, 1896, page 630.

[2] *Physical Review*, Vol. 2, page 116.

Fort Wayne-Siemens & Halske Consolidation.

A consolidation has been effected between the Fort Wayne Electric Corporation, Fort Wayne, Ind., and the Siemens & Halske Electric Company, Chicago. We understand that it was principally through the efforts of Mr. Samuel Insull, of the Chicago Edison Company, that the combination was brought about, and that Mr. Insull will be a director in the consolidated company. The capital stock is stated to be $6,500,000. Mr. R. T. McDonald, president of the Fort Wayne Electric Corporation, it is reported, will be the controlling and guiding spirit of the new concern. According to statements made by Mr. McDonald himself, all papers have been signed completing the negotiations, and an inventory of stocks is now being taken. It is probable, he stated, that the title of the new company will be changed, expressing the opinion that the name of the local company would be the Siemens & Halske-Fort Wayne Electric Corporation. The plants of the two companies at Fort Wayne and Cicero, a suburb of Chicago, will be continued in operation, and the plan of the new company is to produce electrical apparatus and supplies of all kinds, including electric railway equipments and cars. The principal offices of both companies will, it is stated, be maintained at Fort Wayne and Chicago, as heretofore. The new company will have the support of the Siemens & Halske Company in Berlin, which has a capital of $20,000,000. The Chicago branch of the new company will be devoted to the building of electric, elevated and steam cars and equipments. The desire of the Siemens & Halske Company to combine electric lighting with its business and that of the Fort Wayne to engage in the manufacture of electric railway equipments were the basis of this consolidation, and it is proposed under the new arrangement to cover the entire field of applied electricity.

Discharging of Electrified Bodies by Röntgen Rays.

The property possessed by Röntgen rays of inducing in gases the power of discharging electrified bodies has recently been investigated by E. Villari. He has found that this power persists for some time after the rays have ceased and that it is not altogether destroyed by causing the gases to flow through a tube several metres long. It is found also that sparks from an induction coil, influenced or not by a condenser, cause also this discharging phenomenon, the effect increasing at first with the length of the sparks, but decreasing again to zero as the proper length of spark has been exceeded. Dr. Uno Panichi has found that Röntgen rays last no longer than one fiftieth of a second after the excitation of the vacuum tube has ceased, so that any after-effects such as those found by Prof. Villari are entirely due to the modifications in the air traversed by the rays.

Water Power for New York.

"There are unemployed water powers enough within 50 miles of New York to displace every steam engine in the metropolis at a profit, if they were but rendered available."—DR. LOUIS BELL in the *Engineering Magazine*.

Direct Currents from Alternating.

BY ALBERT G. DAVIS.

A patent has recently been issued to Hutin and Leblanc which covers a new and very interesting device for converting alternating currents into direct, and *vice versa*. The machine consists of a peculiar stationary transformer and a small synchronous motor driving a set of rings and a commutator. The device depends on the well-known principle of trigonometry that the square of the sine plus the square of the cosine is unity.

In the illustration, Fig. 1, 3, 3 are the alternating leads and 2, 2 are the alternating primaries, wound in series on the ring core. On the same core are wound a number of secondaries, 4_1, 4_2, etc., connected in series and tapped to a commutator like an ordinary Gramme ring.

Brushes 7, 8 bear on this commutator, and either the commutator or the brushes are revolved in synchronism with the alternating current. Rings 9, 10, with brushes 11, 12, take off the direct current.

The peculiar results obtained depend on the winding of the coils 4. Assuming any small angle a, and using $2n$ coils, the successive coils are wound each with a number of turns proportional to the sine of their angular distance from the point on the core selected as the point of starting, so that the first coil, 4, will be wound with $y \sin a$ turns, where y is a constant selected with reference to the voltage of the direct current desired. And in general the coil 4_p will be wound with a number of turns equal to

$$y \sin \left[a + (p - 1) \frac{2\pi}{2n} \right]$$

Opposite coils are wound oppositely, but have the same number of turns, as $\sin a$ is equal to—$\sin (a + 180°)$. The result is that the number of turns in series between the brushes at any moment is equal to a constant times the algebraic sum of the sines of the arcs forming an arithmetical series, whose common difference is in the case supposed $\frac{2\pi}{2n}$. It is capable of proof by trigonometry that the sum of such a series is a simple sine function, $k \sin x$, where x is the displacement of the brushes from some assumed angle of reference.

But the current admitted to the alternating terminals, 3, 3 follows a sine law, as does also the flux which cuts the secondary coils 4. Each turn of the coils 4 therefore gets up an E. M. F. equal to $b \sin w$. But as the commutator is revolved in synchronism with the current, it is possible to set the brushes at such an angle that w is equal to x. Therefore the total E. M. F. between the brushes is equal to $k\, b \sin^2 x$, or the product of the number of turns in series by the E. M. F. of each turn. A sine square current is unidirectional, as

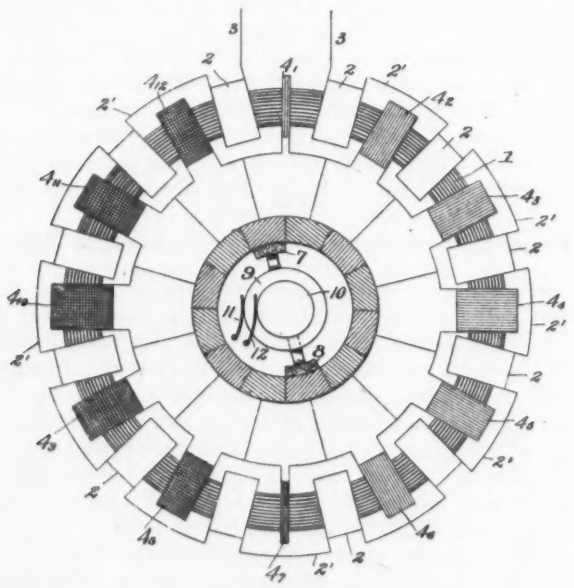


Fig. 1.

any square is by its nature positive, and the result is that a unidirectional current is obtained.

If multiphase currents are available, there might be two such transformers with the brushes of their secondaries connected in series, of which one would be wound with the sine winding and one with the corresponding cosine winding. And as the quarter-phase currents vary in accordance with a sine and cosine law, the resultant E. M. F. will be $k\, b \sin^2 x + k\, b \cos^2 x$, or $k\, b$, a constant direct E. M. F.

In practice the two transformers required by these considerations are combined in one, shown in Fig. 2. 3, 3 are the sine current leads, and 3^1, 3^1 the cosine current leads. Instead of connecting the brushes of two commutators in series, the corresponding coils are connected in series as shown, and the result is the same.

In the machine as built the cores and their windings are placed in

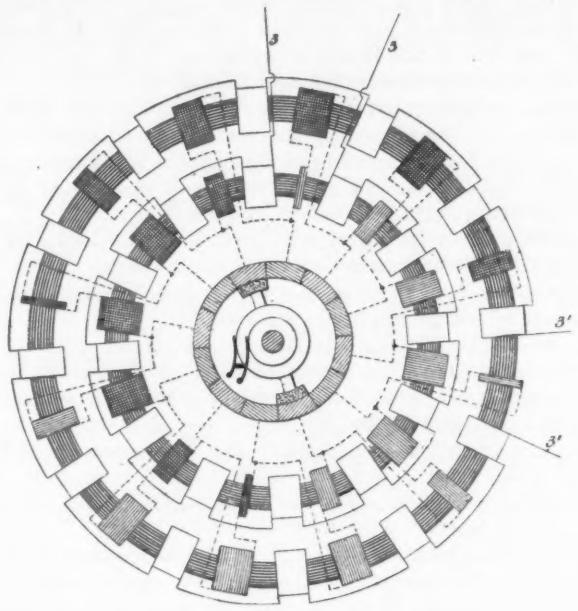


Fig. 2.

boxes at the base of the machine, and above is a large commutator, driven by a synchronous motor. The coils are capped as shown, and the connections are carried through brushes and rings to the segments of the commutator. Two brushes bear on the commutator and take off direct current.

The results are very satisfactory. It is claimed that the machine is absolutely sparkless, and well suited to practical work. There is no moving wire, and in fact no moving parts except the commutator and rings. The friction losses are therefore small, and the cores and coils may be placed out of the way, and give no more trouble than an ordinary stationary transformer. They may be cooled with oil if desired.

The device is an illustration of the fact that pure theorists, by the application of mathematical analysis to known conditions, can evolve satisfactory practical results. It has not been attempted in this sketch to give the analysis in its entirety, but the line of reasoning has been roughly reproduced, and those who are interested are referred to United States Patent 572,510, Dec. 1, 1896.

The Production of Metals in the United States in 1896.

The production of minerals and metals in the United States for the year 1896, according to *The Engineering and Mining Journal*, is given at a total value of $653,311,468, showing a decrease, as compared with 1895, of $24,689,266, or about 3½ per cent. This decrease was largely in values rather than in quantities. The production of aluminum shows an increase of 400,000 pounds over that of 1895, the total for the year being 1,300,000 pounds.

In the production of copper, the increase over last year has been extraordinary, amounting to 67,370,150 pounds. The domestic demand was less, but the increase was largely absorbed by extraordinary exports during the year which are the largest on record.

In 1896 the production of pig iron in the United States amounted to 8,768,869 long tons, a decrease, as compared with 1895, of 677,439 tons, or about 7 per cent.

The production of lead from domestic ores amounted to 175,717 short tons, representing an increase of 20,863 tons as compared with the preceding year. In addition to this there were 79,000 tons produced from imported ores or refined from imported bullion.

The output of quicksilver was 33,012 flasks, a decrease of 966 flasks from the previous year. A flask contains about 76½ pounds. The California mines are the sole source of supply of this metal.

The total production of spelter or commercial zinc for 1896 amounted to 77,084 short tons, showing a decrease of 4774 tons as compared with the production of 1895.

The Electrical Equipment of the Hotel Manhattan.

OF the numerous uses for which electricity has shown its adaptability in the past few years the modern city building is not the least important, and among modern buildings none demonstrates this fact better than New York's newest caravansary, the Hotel Manhattan, situated on Madison Avenue and Forty-second Street, and recently opened under the proprietorship of Messrs Hawk & Wetherbee. This magnificent structure, planned by Mr. H. J. Hardenburgh and built by Messrs. Marc Eidlitz & Son, rests on the solid rock of Manhattan Island, and has a height of 250 feet, being 14 stories above the street level.

As a home for the traveling public, it is safe to say that the ripe experience of the architect, the builders, owners and managers has combined in such a way as to make it unsurpassed in its convenience, taste in decorations, and substantial comfort of its furnishings and apartments. The scope of this article cannot extend beyond a brief description of the complete electrical equipment which has been installed in this hotel.

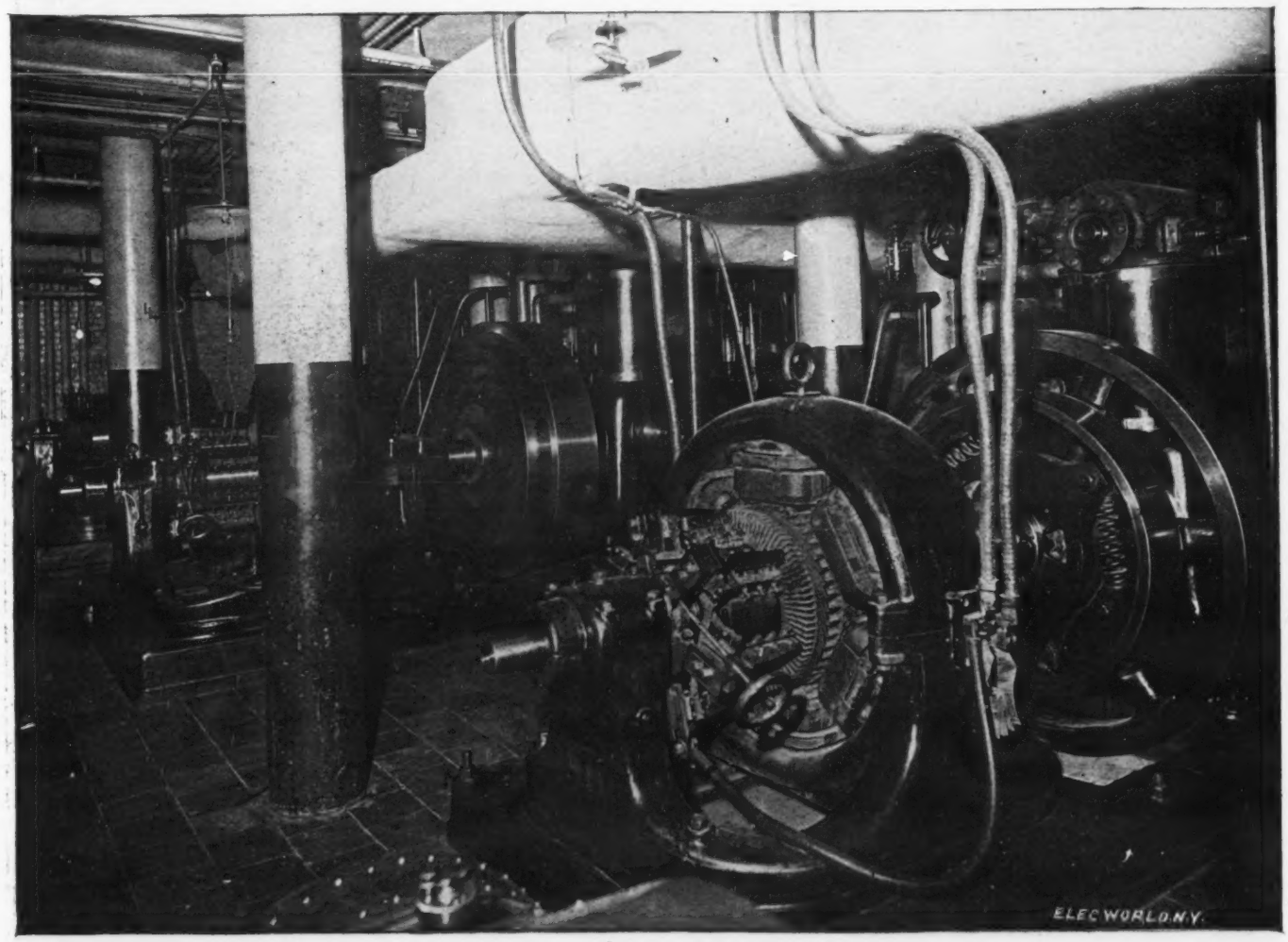
Beginning with the boiler room we find it situated under the main entrance and containing two 150-hp and one 300-hp Babcock & Wilcox boilers, installed, as was also the steam fitting and ventilating plant, by Messrs. Baker, Smith & Co., New York City. The steam is delivered at 100 pounds pressure to four direct-connected Westinghouse engines.

The engines are vertical-compound non-condensing, the exhaust steam being used for heating. As with all Westinghouse engines they are self-contained and self-oiling. They are equipped with Rite's new inertia governor which has heavy working parts and has but one bearing requiring lubrication, the single spring working on knife edges. Two of the generators are of 100-kw, one of 75-kw and one of 50-kw, each being connected to its own engine by flexible spring couplings. They are of the latest six-pole type, with compound-wound poles. The series-coils are adjusted for a rise of about three volts at the switchboard terminals from 115 volts at no load. The current is collected on the 100-kw generators by twenty-four 2¼ x ¾ inch carbon brushes. These have been beveled so that they make a contact of ½ an inch on the commutator, this amount resulting in no sparking. They cover now exactly 1½ bars, there being 204 bars in all. The brushes conduct about 60 amperes per square inch of actual contact. The 75-kw machine is found to run sparklessly with the brushes covering but 1 bar, there being 73 in all. The 50-kw machines run sparklessly with 1¾ bars contact. It has 18 brushes, each 1¾ x ¾ inches. The brushes are firmly clamped in a box supported by a shunted spring hinge, thus ensuring perfectly cool brush holders at all times.

The 100-kw machines have drum-wound armatures, the electrical balance of the six circuits being accurately maintained by cross-connecting the bars which are at a given time under the three sets of positive and negative brushes. Four of these cross-connecting bars are used, the points of connection being equally spaced. This prevents all local currents through the brushes during stopping and starting.

The engines and dynamos were installed by Westinghouse, Church, Kerr & Co., New York City. Everything from the dynamo lugs to the fixture outlets were installed by Mr. C. L. Eidlitz, electrical contractor.

The switchboard is made up of three slabs of gray Tennessee marble and has a total length of 18 feet 6 inches. It is surrounded by a copper frame and all the instruments and switches are finished in copper. The busses and lighting switches are all on the three-wire plan, as are also the mains and feeders, this provision being made so as to use the Edison street current if necessary; no connection is



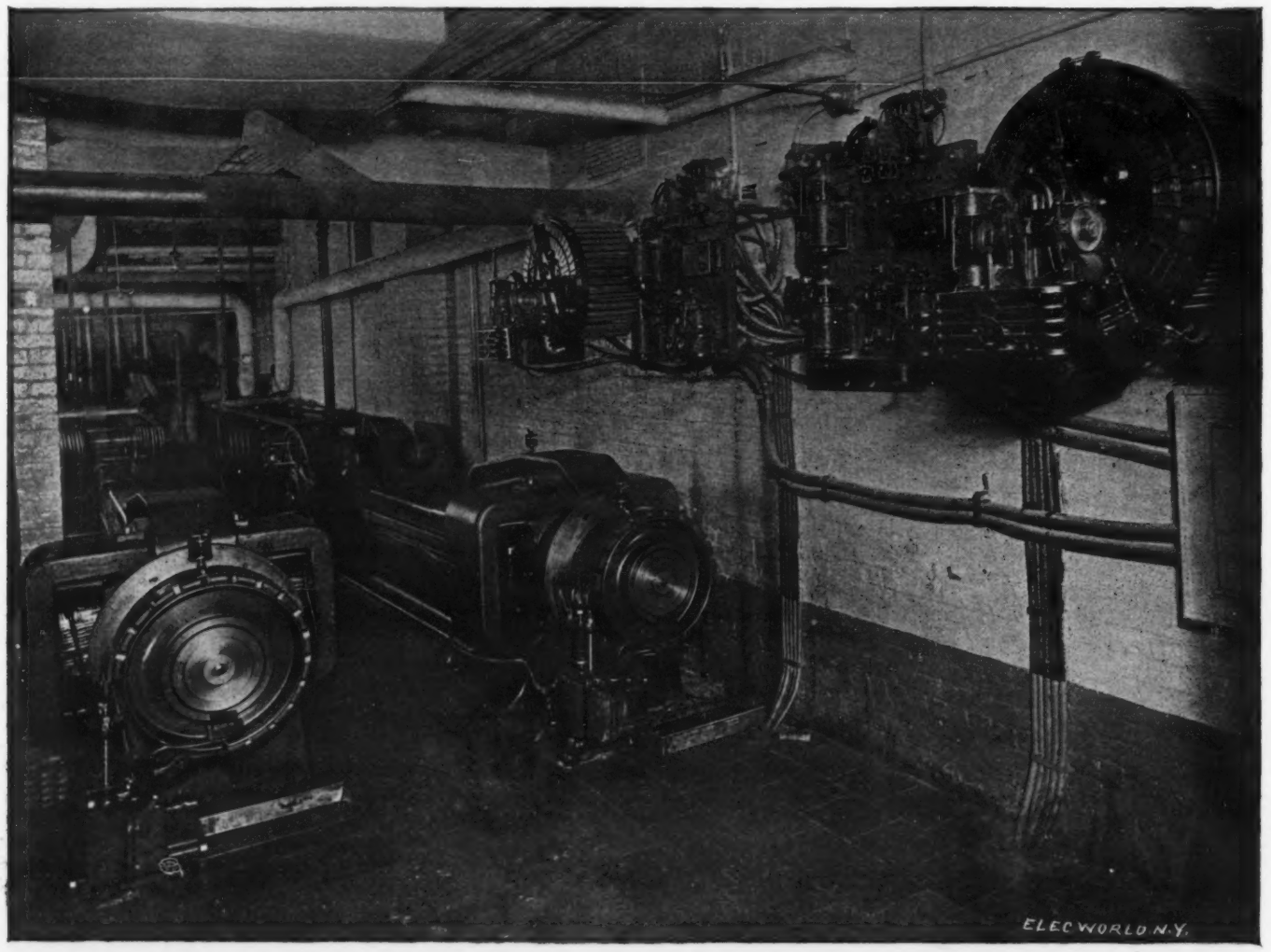
GENERATING SETS IN HOTEL MANHATTAN.

made as yet, however. Each generator is provided with a three-pole double-throw switch, which when thrown to the right puts the machine on the power circuit, and when to the left on the lighting circuit. The light and power busses can be connected by a bus junction switch, thus allowing either one or all machines in parallel to carry the light and power circuits. Carpenter enamel rheostats, Cutter automatic circuit-breakers and Weston illuminated dial instruments are used throughout. There is an ammeter for each generator, which reads 25 per cent. above the generator's capacity. There are also ammeters reading the total output on the light and power circuits. Besides there are on the switchboard one voltmeter, a ground detector and a differential galvanometer. The latter is connected so as to show the difference of voltage between either the light or power busses and any one of the machines; the needle coming to zero when they are equal, thus making it possible to throw in or out machines without perceptibly changing the voltage on the house circuits. There are Thomson recording wattmeters on both the elevator and motor circuits. From the lighting busses the current is distributed by 22 sets of feeders, each supplying several cut-out boxes. These feeders go up in three rises, each set supplying its portion of three floors.

All the lighting wires, manufactured by the Bishop Gutta Percha Company, New York City, are run in iron-armored conduits of the Interior Conduit & Insulation Company. There is a separate pipe for each conductor up to the cut-out boxes, but from these twin wires are used. There are 100,000 feet of conduit tubing installed. The cut-out boxes are slate lined and absolutely fireproof.

The fixtures were manufactured by the Archer Pancoast Company from special designs by the architect. The entire building is most liberally supplied with lights. The chambers, which have about 120 square feet of floor surface and ceilings 11 feet high, with very few exceptions have a centre chandelier of three lamps and two side lights. The parlors have six-light brackets, while the halls are lighted by 12 fixtures on each floor, frosted shades with clear lamps being used, except in the rotunda and the floor of the Transportation Club, where the lamps drop from under the fixture. In most cases the lamps stand up on the chandeliers and are surrounded by figured glass globes. The ladies' dining-room on the first floor, having about 2000 square feet of floor space, is supplied with six chandeliers of 20 lights each. The main parlor or foyer has about 2250 square feet of floor space and a ceiling 16 feet high and is supplied with 70 lights. The main restaurant with 3500 square feet and a ceiling 20 feet high has 140, while the rotunda with the same height of ceiling and 3000 square feet of surface has seven chandeliers each equipped with sixteen 32-cp lamps, besides having 120 sixteen-cp lamps over the skylight. The remainder of the house is lighted in about the same proportion. Sawyer-Man lamps and Westinghouse sockets are used. The entire lighting and generating plant was designed by Mr. C. O. Mailloux.

A very important part of the electrical equipment of the Hotel Manhattan is the Sprague elevator service. There are four 16 to 1 ball-bearing screw machines for operating passenger elevators, one drum freight machine and two dumb-waiters which run to the top of the building. Besides these there are four machines running from the sub-basement to the sidewalk and the office floor. After making a few trips in the cars one is made curious to know how by the handling of a three point switch the car can be made to run at practically any speed either up or down and stop and start without any perceptible jar. The limit of this article will not allow of a detailed description of the controller, but the care and study expended have resulted in one of the most useful as well as interesting developments of electrical applications. The ingenuity displayed in the ball nut, containing from 260 to 300 steel balls, which forces the sheaves, thereby lifting a car loaded with passengers 16 feet to one foot of its movement, is as great from a mechanical standpoint as the controller is from the electrical.



Elevator Machines in Hotel Manhattan.

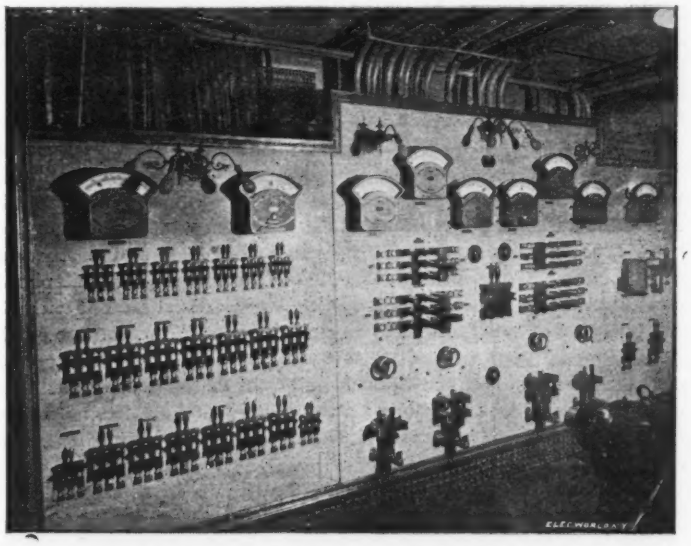
The three-point controlling switch completes a circuit through a pilot motor, which operates the arm of the main controller. Throwing the switch on the up contact excites the pilot motor field in a certain direction, the down contact in the opposite direction, and the

stop contact in the direction opposite to the one last used. These reversals are made by switches operated by an arm connected to the main controller shaft. The different speeds are obtained by holding the switch on the contacts certain lengths of time, thus determining the amount of resistance cut out by the pilot motor. The pilot motor is automatically opened when the controller arm has reached the limit of its travel. The circuits are broken gradually, so that there are no dead stops; this is true of the main circuit and the shunt brake circuit. No current is broken on the face of the rheostat or on the jaws of the copper switches, carbon tips and wheels being used in all cases. Every part of the machine has its own safety appliances. The armature of the screw machines takes current only when the elevator is going up; when coming down the armature generates an E. M. F. of from 80 to 100 volts, depending upon the speed, the fields being excited from the main bus bars, and the current is fed to iron grid resistances, the amount of which is used determining the speed. When the car reaches the bottom of the pit the motor is automatically, but gradually, short-circuited, while the armature circuit is open when the car is at the top floor.

The controller used on the dumb-waiters is similar to the old type of street railway controller. It can be thrown from the off position only when all the landing doors are closed, thus making it impossible for one to be guillotined by the car coming up or down.

The motor equipment used in the Hotel Manhattan consists of one 16 and one 12-hp Triumph ironclad motor situated on the mansard roof and used for driving air fans; one 15-hp Westinghouse multipolar for the laundry; one 5-hp Lundell motor for the ice-crusher and ice cream freezers, one ¼-hp Lundell direct-connected to an exhaust fan, and one Crocker-Wheeler motor transformer used on the teleseme circuits. There are altogether 40 telephones used in different parts of the house on the Acme Interior Telephone system and connected with the central station on the main office floor.

The Herzog teleseme system forms an important part of the electrical equipment. It connects with 300 points and has cards that may be filled out with 144 different signals. It is operated by a Crocker-Wheeler motor dynamo, but in addition an automatic switch has



SWITCHBOARD IN HOTEL MANHATTAN.

been supplied which throws in a primary battery, if for any reason the motor dynamo fails to operate. The two most important features of this system are the chemical annunciator and the indicator dial. When a guest wishes any article or service he places the point of an arrow which is connected to the central shaft of the instrument on the square having the name of the article wanted. He then pushes a button which completes the circuit through a tank containing a white button with the number of each room. The electrolytic action colors the button red. The operator then puts a plug in the hole corresponding to this number in a plug board and then closes a contact which excites a magnet and releases the arrow on the instrument. The arrow is then carried to its original position by springs. In turning back it makes and breaks a circuit by means of a cog-wheel connected to the arrow shaft. The number of breaks or cogs that the arrow passes over before it moves from the portion of the card on which are the signals is determined by the radial column of the desired article. At this point on the wheel there is a space having no breaks. After this is passed the travel of the arrow depends upon the position of the desired article in the radial column. Each step that the arrow is moved toward the centre allows the wheel to pass one more cog before coming to the step. Thus, if the arrow on the dial in the office clicks rapidly to No. 7 and then after passing to No. 9 the operator looks in the column 7, No. 9, and calls "468, ice-water." Within three minutes from the time the guest pushed the button the boy is at the door. That the system is appreciated is shown by the fact that there are on the average 300 calls a day.

The wiring for the telesemes and telephones was done by the Western Electric Company, and consists of rubber insulated wire pulled in brass-armored tubing. There are two interconnecting boxes on each floor, with cross-connecting cables and extra wires for all parts of the house. The hotel is fully equipped with the E. Howard Watch & Clock Company's system of fire alarms and watchmen's buttons.

Returning to the engine room we find an ice plant installed on the Westinghouse compression system. There are two six-ton compressors driven by two 10-hp Westinghouse standard engines. All working parts of the compressors are lubricated by working in oil contained in the crank case. The compression cylinders are water-jacketed, there being two cylinders, each taking ammonia only on one side. The ice is frozen directly on the ammonia pipes, which are immersed in tanks about 5 feet in the freezing tank. When the ice has reached a thickness of 11 inches it is harvested by means of a steam cutter, one bank of ice of about three tons being harvested each day. The cold storage is provided for by pumping brine, which is kept at about 15 degrees Fahrenheit, in a tank similar to the freezing tank, through the coils in the ice boxes situated in the sub-basement, kitchen and serving rooms. The pumping plant consists of one fire pump, 20 x 12 x 10 inches, two compound house pumps, 8 x 12 x 8½ x 10 inches, three boiler feed pumps, 7½ x 5 x 6 inches, and several pumps for the kitchen, laundry and other purposes. They were made by the Dean Steam Pump Company, Holyoke, Mass. The feed water is heated by a Berryman heater. Monitor injectors are supplied, but as a rule are not used inasmuch as it is preferred to heat the feed water with the exhaust steam.

The plant has been in constant operation since Oct. 15 and for some time before that irregularly. The hotel service is practically continuous. The lighting load is never less than 400 amperes during the day and rises at 6 p. m. to about 1400 amperes. This gradually drops to about 900 at 1 a. m., when the cafe and restaurant are closed, the load then dropping to 300 amperes for a few hours and coming up again early in the morning. A total of about 15,500 ampere-hours a day are required for lights exclusively.

The elevators are so distributed over the house that it is impossible to prevent at least four of the passenger and freight machines from operating at the same time, and quite frequently they all start and stop together, so that the elevator load varies from zero to 1200 amperes. This can be taken care of by one of the 100-kw generators, but it has been found to be very satisfactory to operate both light and power on the same machines. The variations of the elevator load are then taken by the different machines, thus relieving one engine from severe strain. The variation in voltage is scarcely perceptible on the lights.

The Liverpool Overhead Railway.

Our English letter this week brings the information that the southern extension of the Liverpool Overhead Railway, which extension is wholly underground, was opened to the public on Dec, 21. Apart from the fact that the title of the company does not altogether harmonize with the character of the road, it can be said to the credit of the management that this is one of the best paying electric railway properties in Great Britain. The road is very successfully operated by electricity, so we are informed, and it thereby furnishes an object lesson for the hesitating influences that control our own elevated roads. To remove from the New York lines the noisy and otherwise disagreeable steam locomotives, and substitute for them the noiseless and clean electric engines would be a great boom to the thousands whose dwelling-places are adjacent to the elevated structure. The conditions of operation are unquestionably different as between New York and Liverpool, but the Liverpool line is by no means a small, experimental affair—it is more than seven miles in length. The road runs along the Liverpool docks, and has extensions to the suburbs at either end The underground extension just opened is three quarters of a mile in length, and in its construction some formidable difficulties were successfully overcome.

The Interests of the Public in the Telephone Situation.—II.

BY F. W. DUNBAR.

THE PRACTICAL LIMITATIONS TO LONG-DISTANCE TELEPHONY.

ONE of the most interesting problems concerning telephony is the limiting distance, commercially speaking, at which conversation may be successfully carried on. It has long been recognized that the telephone current undergoes a large loss upon the line during transmission. The current at the distant end of the line is far less than the current at the transmitting end. This loss is only to a slight extent due to the leakage of the current, unless the circuit be of very low insulation. The electrostatic capacity of the circuit is mainly responsible for this large loss of current, as may be seen by referring to Fig. 4.

The capacity of the circuit may be roughly pictured by showing

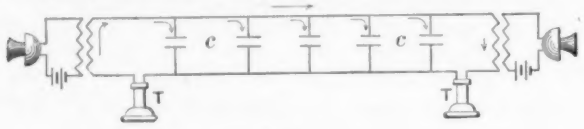


FIG. 4.

the condensers (c, c) bridges across the two sides of the circuit. It is obvious that a considerable portion of the alternating telephone current will be absorbed in charging and discharging these condensers, and only a small portion of the current can be utilized to affect the receiving apparatus at the distant end, if the line is of considerable length. In fact a long line may be "opened" or cut at the receiving end and still but slightly decrease the current given out by the transmitting device at the transmitting end of the circuit. The circuit is "closed" to the transmitting apparatus, through the capacity of the circuit. Again one side of a long circuit may be opened or cut at a point some little distance from either end ot the circuit and still allow conversation to take place between the two terminals of the line. In this latter case, as the uniformity in electrical conditions of the two sides of the circuit has been destroyed, the unequal influence of the electrostatic capacity of each side of the circuit to the earth, while allowing the transmission of the telephone current across the break in the line, will introduce a disturbance on other neighboring circuits on account of the resulting unsymmetrical distribution of current.

These points simply serve to emphasize the fact that while the resistance and insulation of the line-circuit exercise a certain influence upon the transmission of telephone current, yet they are not the controlling elements which limit the distance at which conversation may be carried on. The electrostatic capacity of the circuit, as well as the inductance, are factors which must be considered. Thus it is readily possible to transmit speech through a resistance of many millions of ohms when devoid of any material mutual capacity, as may be secured in a laboratory, but with the same transmitting and receiving apparatus, conversation is commercially impossible over a line circuit, each side of which consists of 1000 miles of No. 12 N. B. W. G. copper wire, although in this latter case the resistance is only about 20,000 ohms, or but a few thousandths of the resistance in the former case. Again, speech can be successfully transmitted over a few hundred miles of this same line wire, even when cut or opened on one side at a central position, thus introducing an infinite resistance at one point of the circuit.

The electrostatic capacity of the circuit is then the element mainly responsible for the limit in distance at which conversation may be conducted. The decrease in current increases rapidly with an increase in the length of circuit, varying inversely as the hyperbolic sine of a function of the length of line. Again, this decrease in current is not constant for all rates of vibration, but in general the loss increases with an increase in pitch. Now, not only the character or the quality of the voice, but the character of speech itself depends upon the simultaneous production of many different rates of vibration. If the telephone fails to accurately transmit and reproduce these different rates of vibration, or overtones, in their correct proportion as regards volume, then when this distortion of the telephone currents passes a certain limit, not only will it become impossible to distinguish one voice from another, but the transmitted tones themselves will lose their characteristics of speech.

This limitation to long-distance telephony has long been recognized and considerably discussed. But does practice indicate that this limit to long-distance telephony has been approached? In other words, is the transmission of speech between distant cities over the long-distance circuits of the American Bell Telephone & Telegraph Company any less distinct or any less devoid of the characteristics of the voice of the speaker than the transmission of speech from one station to another in the same city? Many users of the telephone will say that the contrary is true; that conversation is now satisfactory over the long-distance circuits. The limit which has been reached in long-distance telephony is due, then, not to any lack in the quality of the transmitted speech, but to a deficiency in the volume or energy of the received sound. Were the limit due to the inferior quality of the speech, an increase in its volume would avail nothing. But if the limit be due to a deficiency in the volume or energy of the received current, the obvious remedy is to increase the volume.

I have previously shown that the power of the battery transmitter or microphone is not dependent upon the energy of the voice, but that its power is derived from a separate source of energy, as a battery, and the power of the voice is only used to govern the rate of output of the energy from the battery. This being so, why has a lack of volume or energy caused a limitation to the transmission of speech? The problem of long-distance telephony is as yet merely a problem of the transmission of electrical energy without regard to the distortions of the current due to the various rates of vibration which may be present in the telephone current. Yet a No. 8 B. W. G. copper wire weighing 435 pounds to the mile is used to convey a few thousandths of an ampere of current between New York and Chicago. Such a wire has a safe carrying capacity 100,000 times as great as the current it is actually required to conduct.

The energy furnished to the transmitter by the battery in practice is from two to four watts. The energy actually transmitted to and absorbed by the receiving apparatus at the distant end of a circuit several hundred miles in length is but a few thousandths of a watt. The efficiency of the transmission is therefore only about one tenth of one per cent., or the loss during transmission is about 999 parts in a thousand. However, the efficiency of the transmission on the line itself, that is the efficiency of the external copper circuit, is fully 10 per cent. even in the longest commercial circuits. The transmitting device itself and not the line circuit is mainly responsible for the great lack in efficiency of transmission, yet $120,000 worth of copper alone have been placed in a single talking circuit connecting our two greatest commercial centres in order to raise the efficiency of the line circuit to a point sufficient to allow commercial conversation to be carried on.

In other words, although the battery transmitter is not dependent for its energy upon the power of the voice and although the limitation of telephony has been due to a lack of volume or power of the telephone current, yet the extension of long-distance telephony has been accomplished mainly by the use of superior and costly line-construction. To make the point clear the earliest carbon telephones of Edison are capable of transmitting speech, though not with the same degree of satisfaction, to be sure, which attends the use of the present more modern transmitters over the largest of the present commercial long-distance circuits, and even the magneto-transmitter of Bell, which depends wholly on the energy of the voice, is capable of transmitting speech many hundreds of miles over these same circuits.

The conclusions then which may be drawn in reference to the practical limitations of long-distance telephony are:

The limiting distance of transmission at present reached is due not to any deformation of the telephone currents, which would render the transmitted speech devoid of character, but to a lack of volume or energy of the received sound.

The volume of the received sound may be increased either by a greater expenditure of energy at the transmitting end, or by a more efficient method of transmission, or both, or

The losses upon the line circuit may be reduced by designing the circuits with special reference to the values of the constants, resistance, insulation, capacity and inductance, so that the circuit loss may be a minimum upon a given circuit, or,

Repeating relays, furnishing additional supplies of energy may be located at one or more points on the line in a manner similar to the repeating relays used in telegraphic transmission.

In reference to a greater expenditure of energy at the transmitting end it may be stated that any great increase in the current supplied to the present transmitting device would cause deleterious heating of the transmitter and would not result in increased efficiency of transmission.

In reference to the use of relays it may be noted that the theoretical limitation of telephony, due to the distortion of the voice cur-

rents at a rate increasing rapidly with the length of the circuit, would vanish. For by the employment of relays each section would then become a distinct circuit, electrically, and the total distortion which would occur would be far less than the distortion produced by the complete circuit undivided by the repeaters into sections. Again, the employment of relays overcomes the limitation due to a lack of volume or energy of the telephone current. Just as a battery transmitter depends upon the energy of the voice only to liberate the energy of the battery in undulations similar in form to the sound waves, so a repeating relay depends upon the energy of the received telephone current only to liberate a new supply of energy from a relay battery, and to liberate it in undulations similar in form to the current undulations which it receives from the line. For several years relays which will thus accurately repeat the telephone current, and relay it on with a new supply of energy to a distant point, have been known and used to a limited extent. Such a relay is shown in diagram in Fig. 6. The dotted lines are not to be considered at this point. The receiver or "in"

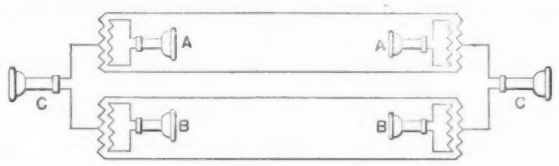


FIG. 5.

current acts upon the relay *R*, which consists of a magnet acting upon an iron armature or diaphragm connected with a variable resistance transmitter in the customary local transmitting circuit. The battery furnishes the additional energy which is transmitted out upon the line through the customary induction coil, in undulations similar in form to the current undulations affecting the magnet of the relay. Such a relay, however, obviously repeats but one way. The return messages from the right hand circuit instead of being repeated would be lost in the repeater itself. Such a device, capable of repeating but one way, has little commercial value in telephony, as each station would have to be equipped with a relay, just as each telegraph station is now equipped with a simple relay for the sounder circuit.

In telegraphy the repeating of messages in both directions is accomplished automatically by means of a double set of relays, connected by an ingenious switching device so that one relay repeats in one direction and the other relay in the opposite direction without mutual interference. To employ a similar device for the repeating of telephone messages would require a switching device of extreme delicacy and quickness of action; otherwise the beginning, at least, of each message, or return response, would be lost. If now the two main circuits be connected by the dotted lines shown in Fig. 6, it will be seen that the relay will be equally responsive to messages from either direction. However, the repeater will then repeat each message in both directions, back upon the "in" circuit with the same prominence as it repeats the message to the "out" circuit. This repeated message will then again affect the relay and be again repeated in both directions. The practical effect is not only a confusion in the transmitted speech, but if the repeater is capable of relaying the telephone current, it will also relay with greater prominence the fundamental rate of vibration of its own diaphragm, causing a prolonged tone, or "howl," as it is called, which will be transmitted to both ends of the circuit to the exclusion of the voice currents. This "howl" is maintained solely at the expense of the energy of the relay battery, and is similar in character and cause of production to the tone secured by placing the opening of the hand telephone against the mouth of the transmitter in a well-kept long-distance telephone set and starting the vibration of the diaphragm of the telephone by a sudden jar, or by blowing across the edge of the mouthpiece of the transmitter.

Many ingenious devices have been devised to place repeating relays in the telephone circuit so as to avoid this interference between the "in" and "out" currents and still accomplish the successful repetition of the telephone messages in both directions. The commercial value of such a repeating device may be readily appreciated when it is considered that by the use of one of these repeaters the heavy No. 8 B. W. G. copper wire weighing 435 pounds to the mile could be replaced by the standard No. 12 N. B. S. G. copper wire weighing but 172 pounds to the mile on the long-distance circuit between New York and Chicago. This would represent a decrease in investment of $75,000 in copper alone for each talking circuit between these two cities. The decrease for 10 talking circuits would be $750,000. The question which naturally arises to the public is whether it is required to maintain the interest and earnings on this extra outlay on account of inherent difficulties which render either the use of repeaters or an increase in the efficiency of transmission impossible, or on account of a lack of competition. The question becomes still more pertinent when it is considered that if our Eastern and Western seaboards were connected together by means of the same inefficient apparatus and methods now employed in long-distance telephony it would require the entire output for three months of our largest copper-producing company to supply the copper for one talking circuit sufficient to yield commercial conversation.

MULTIPLEX TELEPHONY.

In connection with the question of the efficient operation of telephone circuits, the problem of multiplex telephony has an important bearing. Just as two or more messages may be simultaneously transmitted over the same telegraph wire without mutual interference, so may two or more telephone messages be transmitted over the same telephone wires without confusion. The method, however, by which this simultaneous transmission of telephone messages is secured differ from the method employed in multiplex telegraphy.

Fig. 5 indicates one method by which three telephone messages may be simultaneously transmitted by the use of two-line circuits. The local transmitter circuits are not indicated, but are for convenience simply represented by the hand telephones.

The two-line circuits are provided at each end with simple repeating coils, or induction coils, with split secondaries. The stations *A*, *A* converse directly one with the other through the induction coils and over their simple line circuit. Similarly, *B* and *B* converse over the other line circuit. The circuit from *C* to *C* is composed of the two line circuits *A*, *A* and *B*, *B*; *A*, *A* forming one side and *B*, *B* the other side. As the telephone current from *C* enters at the middle points of the secondary circuits of each of the induction coils, and traverses in multiple the two halves of each of these coils, it will divide equally between the two sides of each of the circuits *A*, *A* and *B*, *B*, and consequently the resulting effect of this current on either of the telephones *A*, *A* or *B*, *B* will be *nil*. *C* and *C* thus converse without disturbing either *A*, *A* or *B*, *B*. Also as the circuit of *C*, *C* is formed through the central points of the circuits *A*, *A* and *B*, *B*, that is, through the points of equal potential, no disturbance will be produced by the telephone currents

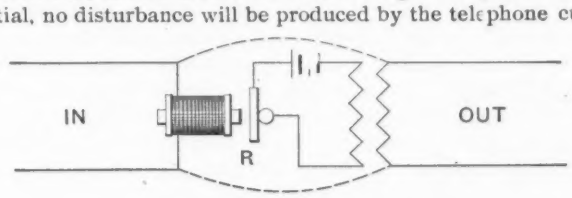


FIG. 6.

of *A*, *A* or *B*, *B* on *C C*. Thus two simple telephone circuits may be utilized for the transmission of three simultaneous messages. Also, another set of two circuits similarly arranged to those of Fig. 5 may be united at the middle points of the derived circuits *C*, *C*, and thus form seven talking circuits from four simple telephone circuits. In general $2n-1$ talking circuits may be formed from n simple telephone circuits, but practical requirements limit a great multiplicity of the circuits. Thus the problem of line transposition is complicated by this compounding of the simple circuits. The circuits *A*, *A* and *B*, *B*, when transposed in the ordinary manner, are rendered practically neutral in inductive effects upon each other and upon other adjacent circuits, yet the circuit *C*, *C*, being formed by the two circuits *A*, *A* and *B*, *B*, will not be entirely neutral to other adjacent circuits unless the circuits *A*, *A* and *B*, *B* are also transposed one with the other. Nevertheless, such a system of multiplex telephony offers a wide field for the more economical and efficient operation of telephone circuits.

Free Central Stations.

Chief Parke, of the Philadelphia Bureau of Gas, computes that the leakage in the Philadelphia gas mains amounts to 1,002,140,315 cubic feet per year. Although we are curious to know how he arrives at such very great accuracy in his figures concerning leakage which is not directly measureable, let us assume that his figures are correct within several million; the value of this gas at $1 per 1000, which is the selling price, is a little over $1,000,000. This, which is the waste every year, would be sufficient to put up a fine electric light plant each year, and when these were established all over the city this leakage would cease altogether.

Principles of Electrical Distribution.—IV.

BY FRANCIS B. CROCKER.

SERIES INCANDESCENT LAMPS ON ARC CIRCUITS.

SEVERAL forms of incandescent lamps have been designed and manufactured for use on the regular 10-ampere arc circuits. These consist of lamps similar in general principle and construction to those used for constant potential, parallel distribution, but containing a shorter filament of larger cross-section, the latter being sufficiently heavy to carry the full current of 10 amperes.

The most important consideration for these circuits is that of maintaining the continuity of the circuit when the filament of any lamp happens to break, which might occur at any time. This may be accomplished by having some form of cut-out which short-circuits the lamp when the filament is broken. One form of this device is called a "film cut-out" and consists of a thin sheet *F* of paper or other material interposed between the points *P* and *P* connected to the conductors *A* and *B* which enter and leave the lamp, as represented in Fig. 3. This film requires the current to pass though the lamp so long as the filament is intact ; but when the filament breaks the difference of potential rises from its ordinary value of 10 or 20 volts to the full E. M. F. of the circuit, which is usually several thousand volts. This high pressure is sufficient to puncture the film, allowing the current to pass directly across between the points *P* and *P*, thus short-circuiting the lamp and re-establishing the continuity of the circuit. In some cases a small electro-magnetic switch is employed, which is caused to close and short circuit the lamp by means of a magnet connected across as a shunt between the leads of the lamp. The coils of this magnet are of high resistance and carry little current until the filament is broken, when the full current strength is thrown through them, causing the switch to close. Either of these devices is quite positive in action since the variation in potential, or current, as the case may be, is very great. They are therefore much more reliable than automatic devices which depend for their action upon slight variations in voltage or current.

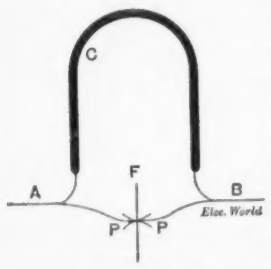


Fig. 3.—Film Cut-Out for Series-Incandescent Lamp.

"Muncipal" Series Incandescent Systems.—These are similar to the preceding one, but instead of operating with a regular arc-lighting current of 10 amperes they are usually designed for about 3 or 3.5 amperes. This gives a filament of sufficient length and cross-section to be durable, and yet does not require excessively large leading-in wires. The lamps are made of various sizes, requiring about one volt per candle power. The practice with this system is to feed the circuit with a constant potential, of 1000 volts for example. When the filament of a lamp breaks and it is automatically cut out of the circuit, the current increases in strength, since the total resistance is reduced, the potential remaining constant. This increase of current is indicated by an ampere meter, or by the brightening of a lamp in the station, and is corrected and brought back to its normal value by switching in an extra lamp in the station. This is usually done by an attendant who is kept on duty to watch the various circuits. The system is rather a crude one, and is rarely used except for street lighting in place of arc lights where the more powerful light of the latter is not required. These systems have not been very extensively introduced, however, and would seem to require some more perfect means for regulation before they deserve to be generally adopted. Several of these circuits may be operated from the same dynamo, all of them being supplied with the same potential. Either the direct or alternating current is applicable to this method of distribution, and are in actual use. The dynamo required consists simply of a generator designed to yield a constant potential of a given value, being equal to the sum of the voltages required by the lamps of each circuit. The current capacity of the dynamo must be sufficient to supply the various circuits in parallel. A shunt or compound wound direct-current machine, or a separately excited or composite alternator would be suitable to the purpose. In the case of the compound or composite machines, they should simply give an absolutely constant potential, since the number of lamps, and therefore the drop, on each circuit is constant.

CONSTANT POTENTIAL PARALLEL SYSTEMS.

Parallel systems operating at constant potential are far more important in electrical distribution than series systems, since practically all incandescent lamps, a large proportion of arc lamps, and nearly all electric motors, are supplied by the former. Constant potential circuits are usually much more complicated than the simple series systems, there being only a single path for the current in the latter case, while with parallel connections there are a number of branching paths. Furthermore, the maintenance of a uniform voltage over a large district is exceedingly difficult. The "drop" or loss of voltage, which is due to the resistance of conductors, is particularly objectionable in incandescent lighting, since the slightest decrease of potential produces a very considerable diminution of light. For example, the candle-power is reduced from 16 to 15, which is more than 6 per cent., when the pressure falls from 110 to 109 volts, or less than 1 per cent. Such a very small variation in pressure would hardly be appreciable in any other practical work, as steam or gas distribution.

The drop in pressure produces three different effects in the lamps or other devices supplied by parallel circuits :

(1) All of the lamps receive a lower voltage than that generated by the dynamo.

(2) Some lamps may be supplied with a lower pressure than others.

(3) The potential at some lamps may vary when others are thrown on or off the same circuit.

The least harmful of these effects is the first, which merely requires the generator to be run at a little higher voltage, and does not necessarily involve any reduction or any difference in candle-power of the lamps, since the drop may be made substantially the same for all, in some of the ways described later.

On the other hand, *variations* in the candle power of lamps due to either of the last two effects are extremely objectionable and difficult to overcome. In order to study these problems let us take a specific case and assume that 100 incandescent lamps are to be supplied with electric current. They are supposed to be divided into five groups of 20 lamps each ; each lamp requires a current of 110 volts and one half ampere and gives 16 candle-power ; therefore one group takes 10 amperes, the total current being 50 amperes. The members of each group of lamps are connected in parallel in the usual manner, but will be indicated by a single line in the following diagrams in order to avoid confusion. These groups are assumed to be 200 feet apart in a straight line, making a total distance of 800 feet between the extreme groups, as shown in Fig. 4. The five groups of lamps represented by the light vertical lines are connected together by two conductors, which are shown as heavy horizontal lines. These conductors correspond to the so-called *mains* in electrical distribution systems, to which are connected the *leads* or small branch wires actually supplying the lamps. The mains receive their current through *feeders* which connect them with the generating plant. As a general rule no lamps are connected directly to the feeders.

In the first case, represented in Fig. 4, the mains are supposed to be fed at one end, the feeding points being represented by short

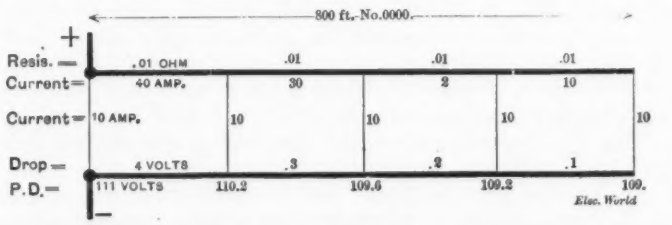


Fig. 4.—Feeding at One End of Main ; 1025 Lbs. Copper ; 2 Volts Max. Difference Between Lamps ; 111 Volts at Feeding Points + and — ; 1.2 Volts Average Drop.

vertical lines marked + and — respectively. The mains are assumed to consist of No. 0000 wire, A. W. G., which would weigh 1025 pounds for the 1600 feet required. It will be seen that a potential of 111 volts, supplied at the feeding points, gives 109 volts at the other end, therefore no lamp receives a pressure more than one volt greater or less than the normal value of 110 volts.

In the second case, Fig. 5, the mains are supposed to be fed at their centres as shown. In this case No. 2 wire, weighing 321.5 pounds, gives almost exactly the same variations of potential as in the preceding case, the maximum pressure being 111 volts and the minimum 109.08 volts. This shows that a great saving of copper is effected by simply feeding the mains in the middle rather than at the ends. Theoretically, it would only require one-quarter as much copper in the former case. This is easily seen when it is considered

that the mains in Fig. 5 on each side of the feeding point are one half as long and carry one half as much current as those in Fig. 4, consequently the conductor will be one-quarter of the cross-section to give the same drop. The weight is found to be slightly more than one quarter in the examples because the nearest regular size of wire was taken in each case, in order to make the examples as simple and practical as possible.

The next case, Fig. 6, represents the mains fed at opposite points. This is sometimes called the *Werdermann* system, after its inventor, and sometimes the *loop* or *anti-parallel* method of distribution. In this case the same length (1600 feet) of No. 4 wire, weighing only 202.2 pounds, gives an equally good distribution of potential. It is sometimes supposed that this arrangement must give a perfectly uniform potential at the lamps, since the sum of the distances of each lamp from the feeding points on the two mains is a constant. As a matter of fact, however, the middle lamps will receive a lower voltage than those at the ends, as shown in the diagram. This is due to the fact that the middle lamps are supplied through the portions of the main conductors which carry heavy currents, and in which the drop is greatest. For example, the drop on the mains in the case of the central group of lamps is $2 + 1.5 + 1.5 + 2 = 7$ volts, but for the end group of lamps it is only $2 + 1.5 + 1 + 0.5 = 5$ volts. It is possible, however, to secure a perfectly uniform pressure at all points between the mains, if their cross-section is made proportional to the current in each section. In this way the drop in each section will be the same, and every lamp will be supplied with exactly the same pressure. The use of these tapering, or so-called "conical," conductors is somewhat objectionable from a practical point of view, since it would require considerable extra trouble to lay them; but it is evidently practicable in many cases to proportion the size of each length of wire to the current that it must carry without involving much additional trouble, since the wire is laid in sections between cut-outs at which its size can easily be changed. For example, each of the sections of the mains shown in Fig. 6 could consist of a different size of wire.

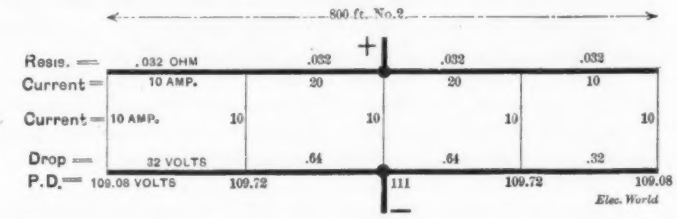


FIG. 5.—FEEDING AT MIDDLE OF MAINS; 321.5 LBS. COPPER; 1.92 VOLTS MAX. DIFFERENCE BETWEEN LAMPS; 111 VOLTS AT FEEDING POINTS + AND —; 1.3 VOLTS AVERAGE DROP.

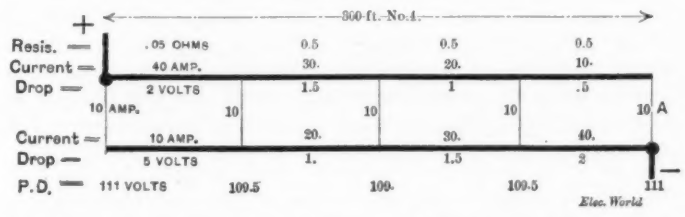

+
800 ft. No.4.
Resis. — .05 OHMS 0.5 0.5 0.5
Current = 40 AMP. 30. 20. 10.
Drop = 2 VOLTS 1.5 1 .5
10 AMP. 10 10 10 10 A
Current = 10 AMP. 20. 30. 40.
Drop — 5 VOLTS 1. 1.5 2
P.D. = 111 VOLTS 109.5 109. 109.5 111
—
Elec. World

FIG. 6.—FEEDING AT OPPOSITE ENDS OF MAINS; 202.2 LBS. COPPER; 2 VOLTS MAX. DIFFERENCE BETWEEN LAMPS; 116 VOLTS BETWEEN FEEDING POINTS + AND —; 6 VOLTS AVERAGE DROP.

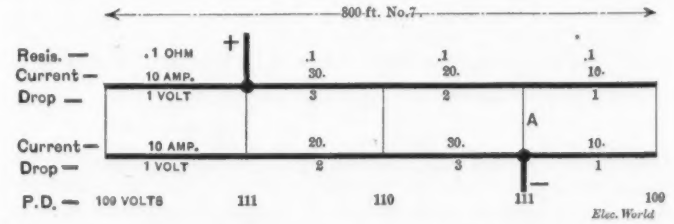

800 ft. No.7.
Resis. — .1 OHM .1 .1 .1
Current — 10 AMP. 30. 20. 10.
Drop — 1 VOLT 3 2 1
A
Current — 10 AMP. 20. 30. 10.
Drop — 1 VOLT 2 3 1
P.D. — 109 VOLTS 111 110 111 109
+
—
Elec. World

FIG. 7.—FEEDING AT DISTRIBUTED POINTS ON MAINS; 101 LBS. OF COPPER; 2 VOLTS MAX. DIFFERENCE BETWEEN LAMPS; 116 VOLTS BETWEEN FEEDING POINTS + AND —; 6 VOLTS AVERAGE DROP.

In the next example the mains are fed at distributed points as represented in Fig. 7. In this case No. 7 wire, weighing only 101 pounds, gives no greater variation in voltage (*i. e.* one volt from the normal) than No. 0000 wire, weighing 1025 pounds in Fig. 4. These examples show the great difference that is made by changing the points at which the feeders are connected to the mains.

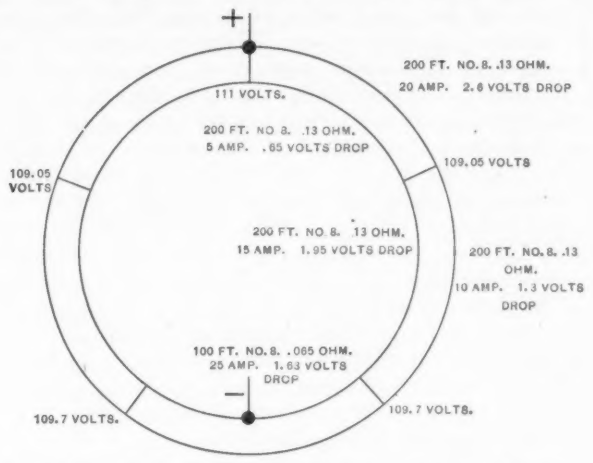


FIG. 8.—CLOSED RING; 2000 FT. NO. 8; 100 LBS. COPPER; 115.23 VOLTS BETWEEN FEEDING POINTS + AND —; 1.95 VOLTS MAX. DIFFERENCE BETWEEN LAMPS; 5.53 VOLTS AVERAGE DROP.

It should be carefully noted, however, that in both the last two cases (Figs. 6 and 7) the feeders must supply 116 volts to the mains instead of only 111 volts, as in the two previous examples (Figs. 4 and 5). In Fig. 6, for instance, the difference of potential between the feeding points + and — must be 116 volts, in order that the end group *A* shall receive 111 volts, since there is a drop of

$$2 + 1.5 + 1. + 0.5 = 5 \text{ volts}$$

in the upper main. Similar reasoning applies to the group *A* in Fig. 7. This necessity for supplying a considerably higher voltage at the feeding points of the mains is disadvantageous in two respects. First, it involves a loss of energy in watts equal to the extra pressure multiplied by the total current, and, second, it may allow great variations in potential to occur when a large number of lamps are thrown on or off the circuit. For example, if all the lamps except one were put out the remaining one would receive practically the full pressure of 116 volts. This may be overcome by reducing simultaneously the voltage of the feeders, either by automatic or hand regulation, employing some of the methods described later.

A futher extension of the principles shown in Figs. 6 and 7 is indicated in Fig. 8, in which five groups of lamps are connected across the mains which form complete circles, being fed at diametrically opposite points. In this case 2000 feet of No. 8 wire, weighing 100 pounds, is used instead of 1600 feet as in the previous examples. A similar arrangement is shown in Fig. 9, but the lamps are assumed to be divided into four groups of 25 lamps each. All the lamps receive exactly the same voltage, 1600 feet of No. 10 wire, weighing only 50 pounds, being required. This exact equality in voltage is due to this being a special case in which the lamps happen to be symmetrically placed with respect to the feeding points. In Fig 6, for example, the second and fourth groups of lamps have exactly the same voltage since they are equally distant from the feeders. But the pressure at the feeding points is high in Fig. 9.

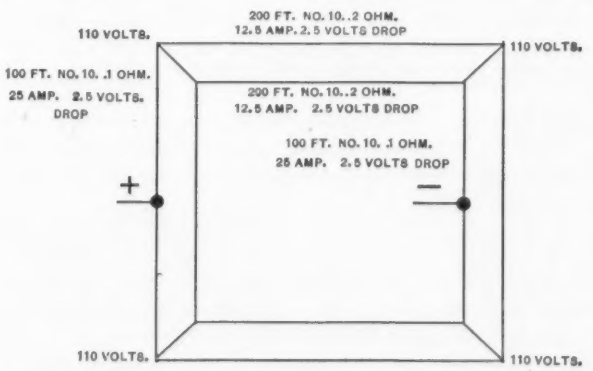


FIG. 9.—CLOSED SQUARE; 1600 FT. NO. 10; 50.3 LBS. COPPER; NO DIFFERENCE BETWEEN LAMPS; 117.5 VOLTS BETWEEN POINTS + AND —; 7.5 VOLTS AVERAGE DROP.

(*To be continued.*)

The Use of Storage Batteries in Railway Work.

BY WM. BAXTER, JR.

NOW that the construction of storage batteries has been so improved that we can depend upon them, the advantages to be derived from their use are well worthy of consideration. It has been demonstrated, in a practical way, that their use in the station, to take care of the maximum demand, will effect a reduction in the capacity of station machinery of over 33 per cent., for the same output, while at the same time the cost of operation is correspondingly cut down. As this fact is conceded by every one conversant with the practical operation of plants provided with storage batteries, it is not necessary to show why it is so, although the demonstration would be very simple. It is desirable, however, to consider the various ways in which batteries may be used, and thus to determine what is the best arrangement, that is if what is the best in one case is the best in all, and if this is not so, (and the conditions determine to a large extent the system best adapted to any given conditions), then it is desirable to know what these affecting conditions are.

There are several ways in which the use of storage batteries may be advantageous and all must be taken into account in considering the adaptability of any arrangement to any particular case. The point of first importance, no doubt, is the effect upon the cost of the plant and of but slightly less moment is the cost of operation. To these must be added the reliability of operation and the uniformity of the current-pressure at the different points of utilization.

When batteries are located in the station they are used to equalize the load on the engines by storing energy during the hours of light demand and giving it back during the hours of maximum demand, and as they only have to take care of the difference between the average and the maximum loads their capacity need not be very great, and in fact it is small in comparison with the capacity of the engines. With this arrangement the load on the engines is equalized, but the pressure at the points of delivery along the line is not maintained any more uniformly than when they are not used and the full benefit of the batteries in the way of reducing cost of plant is not realized. If the batteries are located along the line their cost will be somewhat greater for reasons that will be given hereafter, but the advantage will be that the pressure can be kept more nearly constant, and furthermore the cost of the line can be considerably reduced.

There is another way in which the batteries may be used which has not received very much attention up to the present time, but which when fully investigated will be found to possess many advantages for long or large transmissions. This way is to have them play the part of transformers as well as equalizers of the load. The advantage of this arrangement is that the line wire can be greatly reduced, since the energy can be transmitted over most of the distance at a very high E. M. F. The disadvantage is that the batteries would have to be of a capacity equal to that of a station output, and in fact more, because as they would be charged by a current of high voltage they could not be connected with the line while charging, hence two sets would be required. Notwithstanding this great increase in cost of battery plant it will be found that in many cases the arrangement will cause a reduction in the total outlay.

In order to be able to obtain quantitative results it is necessary to make a comparison with reference to a particular case; then we can see whether the increased cost of batteries can be offset by the reduction in line cost or not.

For the purpose of this comparison we will take the case presented by Mr. R. McCulloch, in his very valuable paper read before the St. Louis Convention of the American Street Railway Association. The diagram, Fig. 1, which is a copy of the one given by Mr. McCulloch, shows that the difference between the average load, which is represented by the height of the rectangle *A*, *B*, and the maximum demand is about 50 per cent., but as this maximum is of only short duration the battery capacity to take care of it need not be this much, since all that is necessary is to provide cells that when working at the highest allowable rate of discharge for a short period of time will be able to deliver a current equal to *D* and that can be charged at the rate *C* without injury. The peak measured by *D* represents the greatest drain upon the battery, which is about 1300 amperes, and the highest rate of charge which is equal to *C* amounts to about 1700 amperes. From this we can see that the battery capacity should be such that it could work up to a maximum of 1300 amperes, but its average delivery would be very much below this point. The maximum capacity of the battery may safely be taken as equal to the one-hour rate of discharge, and from the catalogue of one of the most prominent battery companies we find that the eight-hour rate of a cell that will deliver 1300 amperes for one hour is 380 amperes. To be safe we can assume that as the charging rate will run up to 1700, a cell that would deliver 420 amperes at an eight-hour rate would be the proper size to use. From this it can be seen that if the battery is used to take care of the excess during the hours of heavy demand, the capacity required would be about 420 amperes; but if the batteries are used along the line as transformers as well as equalizers their capacity would have to be equal to the average output of the station or 2300 amperes, which is about five and a half times as much, and as there would have to be two sets of cells so that one might be charged while the other one was being discharged, the actual difference would be about eleven to one.

The natural inference that would be drawn from these figures would be that the transformer system could not be used on account of the great investment in batteries; but in the following paragraphs it will be shown that this is not the case under all conditions.

It is evident that the only way for this difference in the cost of the batteries to be offset is by a reduction in the line wire, and in order to show what this would amount to under certain conditions it will be necessary to assume a length of line, and also the rate at which the energy is distributed along the same. For this purpose we will take the case shown in Fig. 2, and assume the line to be 12 miles long. The diagram shows the arrangement wherein the batteries are used as transformers, but it will be well to first determine what the line would cost if the batteries were located in the station. As has been stated above, the capacity of the cells, when the battery is located in the station, would be 420 amperes at a discharge rate of eight hours, and such cells would cost about $340 each. As there would be required say 280 cells to deliver the current to the line at a pressure of 550 volts, the cost would be about $93,000. If we calculate the line to be of sufficient capacity to deliver the average current with an equal distribution at all points, and to reach the end with a drop of 60 volts, we will find that the weight of copper would be about 2,800,000 pounds, and this, at the rate of 16 cents per pound, would cost about $450,000. The outlay therefore for the station battery and the line wire would be:

For battery	$93,000
For line wire	$450,000
Total	$543,000

In this calculation it must be remembered that the line has been

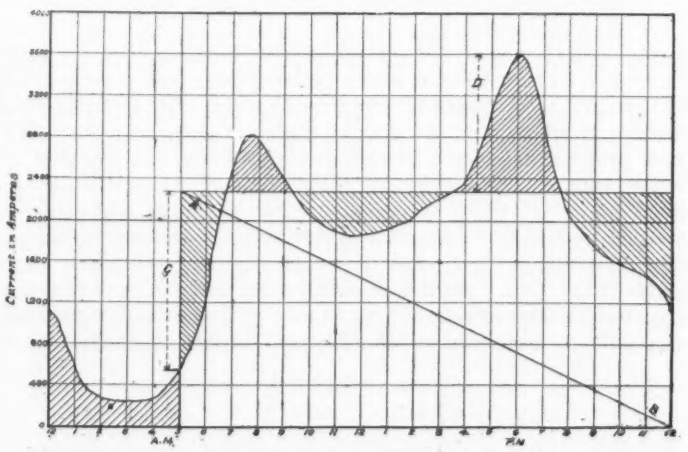


FIG. 1.

calculated for the average current, and therefore the drop with the maximum load would be very much greater than 60 volts and probably as much more as to make the service very unsatisfactory.

With the batteries located along the line, the cost would be about as follows: For the cells, if the line is divided into six sections, as shown in the diagram, and the supposition is made, as in the previous calculation, that the energy is distributed equally in all points, the capacity of each station would have to be one sixth of the average output of the central station, that is 2300 ÷ 6, 385 amperes. The maximum capacity would have to be greater than one sixth of the maximum of the entire line, owing to the fact that the excessive demand may not be always equally divided; we will therefore allow 50 per cent. increase to provide for the concentration of abnormal loads at any point. On this basis the maximum discharge rate of

the batteries should be about 900 amperes. Cells of this capacity will discharge at the rate of 385 amperes in about four hours, and therefore would be ample for the work, as it would not entail an excessive amount of labor to shift the current from one to the other as often as that. These cells would cost about $180 each, and as the distance over which their current would be distributed would be short and the drop could be kept low without a large investment in copper, 260 cells would be sufficient to meet the requirements and the cost would be about $45,000. As each battery would have to be duplicated, the cost per station would be $90,000, and for the entire equipment $540,000, which is over six times as much as in the case of the station battery, but great as is this difference, it does not render the system prohibitive, as will presently be seen.

The cost of the line from the stations to the points of delivery would be very low, and would really only amount to the value of the trolley wire. The maximum current from any one station could be taken as equal to the sixth part of the central-station maximum, or about 600 amperes. This would have to be distributed over a distance of one mile each way, and if we take the weight of wire required to effect this distribution with a drop of 50 volts at points midway between stations, we will find it to be about 5300 pounds per station, or say 32,000 pounds in all, which at 16 cents per pound equals about $5100.

The line for feeding the batteries would be 24 miles long, as on account of the high E. M. F. a ground return would not be advisable. There being six batteries in series the pressure would be something over 3000 volts, and the current would be cut down to one sixth, which, as has been shown in the foregoing, would be 385 amperes. As the battery stations would take care of the fluctuation this charging current would be constant. If we allow a drop of 10 per cent. over the entire line the weight of copper would be about 650,000 pounds, equal to eight No. 0000 wires. The cost of this line at 16 cents would be about $104,000, hence the total cost of the battery stations and the lines would be as follows :

For batteries	$540,000
For trolley line	5,100
For battery feeders	104,000
Total	$649,000

This amount is about $106,000 more than the cost of the battery in the station, but it must be remembered that in that arrangement the line was calculated for the average current; it will be shown further on that if the line is made of sufficient capacity to keep the drop within reasonable limits with the maximum loads, the cost of the battery station system will be the cheapest even for the length of the line here considered. But it can also be shown that if the distance of transmission is slightly increased, the latter arrangement will be the least expensive, even when the former is provided with line wire sufficient only for the average current. A reduction in the number of stations will also enable the battery transformer station method to show better results on short lines. As an illustration, take the same conditions as in the calculation just made and make the number of stations four. On this basis it is evident that the feeder-line will not be effected, but the distribution or trolley line will, as the distance of distribution will be increased from two to three miles, while the current will be 50 per cent. greater; hence the cost of wire will be about three times as great, say 15,500. The cost of batteries will be reduced, owing to the fact that as each unit is larger the reserve capacity need not be as much relatively as when six stations are used. As the maximum discharge rate corresponding to the central-station maximum would be 900 amperes, it would be unnecessary to provide a greater capacity that 900 amperes, and cells capable of meeting this maximum would cost about $240 each, and there being 520 in the two sets, the battery per station would cost about $125,000, hence the total cost of batteries and line would be as follows:

For feeder line	$104,000
For trolley line	15,500
For batteries	500,000
Total	$619,000

Thus we see that by reducing the number of stations to four we cut down the cost nearly $35,000. We do not get down to the figures of the arrangement in which the battery is located in the station, but as an offset we have the fact that the pressure along the line can be kept up with the maximum demand, as the trolley line is figured to meet these conditions.

If the distance between the stations is increased by making the total length of the line greater, the advantage of the transformer system becomes apparent at once, as will be seen from the following :

Suppose the distance between stations to be three miles, which would make the total length of line 18 miles. Under these conditions the cost of the batteries would remain the same, but that of the line would be increased. As the trolley line would be 50 per cent. longer, the weight would be increased about two and one quarter times, hence the cost would be about $13,000. The increase in the cost of feeders would be in the same ratio, and therefore they would cost about $235,000. We would then have for total cost of lines and batteries, with stations three miles apart, the following amounts :

For batteries	$540,000
For trolley lines	13,000
For feeder line	235,000
Total	$788,000

The cost of the batteries and line for the same distance with the battery in the station would be as follows: For the batteries, the same as in the first estimate, that is, $93,000; but the line being 50 per cent. longer would cost two and a quarter times as much, or $1,025,000; hence we would have:

Cost of batteries	$93,000
Cost of line	1,025,000
Total	$1,118,000
Cost with battery stations	788 000
Difference	$330,000

From this it will be seen that for long transmissions, using the batteries as transformers will prove more economical in first cost than if placed in the station, and in addition will keep the voltage more uniform, owing to the fact that the line is topped at frequent intervals, and that its carrying capacity is sufficient to meet the maximum demand.

Locating the batteries in the station is the poorest arrangement that can be made for lines of any length, as it only serves to keep the load uniform on the engines, and does not in any way tend to reduce the cost of the feeders, but even when the batteries are

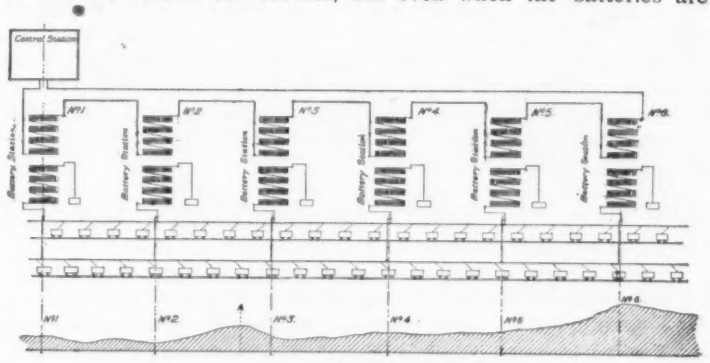


FIG. 2.

located along the line, if they are connected in parallel with the working circuit, the cost of installation will be greater than by the transformer method after the distance of transmission reaches a certain point.

Fig. 3 shows another way in which batteries may be used as transformers, but it has so many objectionable features that it may be regarded as wholly impracticable, and would hardly be worthy of any notice if it were not for the fact that it is sometimes desirable to know what the weak points of a system are so as to avoid making the mistake of attempting to utilize them. In this arrangement the batteries are used to add E. M. F. to the line at intervals, so as to be able to reduce the amount of copper and at the same time keep the voltage from dropping too low. The whole current in the line at each station must pass through the batteries, and consequently the cost of the latter would be very great. In the plan shown in Fig. 2 each battery station is of a capacity sufficient to take care of the section of the line that it feeds, but in this arrangement the battery in the first station would have to be large enough to carry all the station capacity except that distributed before reaching that point; that is, five sixths of the whole. The next battery would have to be equal to four sixths, the next to three sixths, and so on to the last one which would be of the same capacity, as those used in Fig. 2. As the office of these batteries would be to increase the voltage, the voltage, their E. M. F., could not be much over 40 or 50 volts, and even if all are strung in series in the process of charging, the pressure of the current would be lower than that of the working cir-

cuit, and therefore the weight of the wire required would be very much greater. This objection can be overcome by connecting the cells in series for charging and in parallel for discharging, as shown in the diagram, but this plan is not advisable in practice as the cells do not work well in parallel, owing to the fact that it is almost impossible to obtain equality of action in all. Another objection to the arrangement is, that unless the points *A* and *B*, where the battery

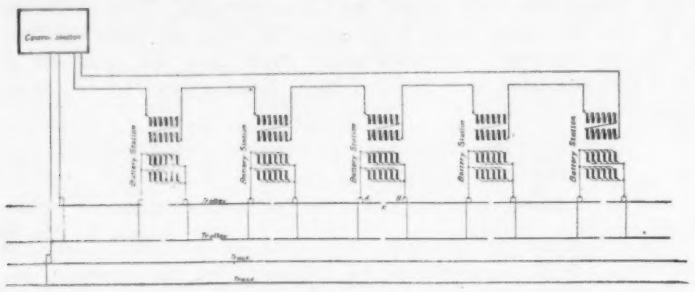


FIG. 3.

wires connect with the line, are at a considerable distance from *C*, there will be quite a difference of potential between the two terminals at this point, and, as a result, the cars in passing it would have their velocity considerably changed.

The few facts pointed out in the foregoing paragraph show that the plan is wholly impractical and its study only serves to show what should not be used.

(To be continued.)

Decorative Lighting.*

BY E. J. JENNESS.

In taking up this subject of decorative lighting, I will first consider lighting effects as applied to scenic theatres. The first thing is to know the scene to be lighted and what effects are to be produced. For an illustration I will use a scene that was probably familiar to some of you during the Summer of 1893, the Scenic Theatre of the Western Electric Company, Electricity Building, World's Fair. That shown there consisted of an imaginary Swiss scene, with a small village in the foreground, gradually rising ground, foot hills and mountains for background. The effects desired were to imitate those produced by nature in 24 hours

1, early dawn; 2, sunrise; 3, morning; 4, noonday; 5, gathering storm; 6, storm; 7, clears off; 8, afternoon; 9, sunset; 10, twilight and stars, and 11, moonlight.

To produce these effects it is necessary that the operator be familiar with all the combination of lights under his control. This knowledge can only be acquired by actual practical experience in operating a scenic theatre. To properly light this scene with a proscenium opening about 8 x 10 feet requires the equivalent of 300 16-cp lamps, and about 125 amperes at 110 volts for the most brilliant illustration. Any standard theatre dimmer can be used that can be controlled mechanically and does not cut out the resistance too rapidly and by too great steps. The rheostats which we use are of the B. F. type (Barriston & Fanning) consisting of sheet iron drum insulated with asbestos and wound with German silver wire of different gauges, beginning with large wire at one end and gradually reducing the size. These rheostats are mounted on a frame carrying a shaft with tight and loose pulleys for operating the contact slide up or down automatically. The location of rheostat must be where the operator can have full view of the scene, otherwise the effects produced can never be satisfactory, as at times the very closest attention is necessary. The rheostat should have sufficient capacity to dim out the circuits to which it is connected, as absolute darkness is necessary at times. The arrangement of lights in the scene is as follows: All lamps are mounted in tin-lined gutters. Overhead three rows of 20 lights each are placed, one row of ground glass, one row of red and one row of blue lights. The right of the proscenium has two rows of 10 lights each, one of red and one row of blue lights.

The foot hills have two rows of 10 lights each, one of red and one of blue. The mountain, two rows of 15 lights each, one of red and one of blue. Left hand lights same as right hand. All blue lamps are of 32 candle-power. The sun consisted of 15 32-cp lamps of 80 volts, on a 110-volt circuit; the moon of 3 16-cp green; the stars of 35 16-cp behind the sky curtain small holes being pierced through.

The different effects are produced by the following combination of lights: Early dawn, ground glass at very low candle power; just before sunrise, ground glass, east reds are used with the sun behind a red-brown glass, operated at one half candle-power. For sunrise, ground glass reds, sun at full candle-power but still behind glass. Morning, ground glass reds; sun moves from behind glass. Noonday, sun and blues; the blues clear out the haze which is common in the morning light. Storm, sun very low, ground glass, little red.

Lightning is produced with a stereopticon outfit having a camera shutter; the slide having different kinds of lightning scratched on the surface. Sunset color about the same as sunrise, with little more red and some blue; for the purple effects, great care is necessary at this point to dim the sun, blues and reds at the right time, or all the brilliant purple effects will be lost and a sickly blue produced that is far from desirable.

In setting up and adjusting the rheostats to stop at the right point, the operator should use plenty of time and bring these effects on slowly, so as to become familiar with the exact effect produced by any circuit coming in at any time. For example, at noonday, with the sun at full power, the reds can be added and the red will hardly be noticed; if this is done in the morning the result would be somewhat startling.

In operating the apparatus to produce the 24 hour cycle: Beginning, darkness; for early dawn rheostat controlling the ground glass circuit is started as this light begins to show, the red borders begin; as soon as the reds are seen the sun rheostat is started. As soon as the sun is at full candle-power it is moved from behind the glass screen, and blues added; when blues are up it is noon. The reds have been dimmed out while blues were coming in. By dimming the blues, then the sun, and adding a little red, the proper sky for a storm is obtained. Now comes the lightning, then the clearing sky, by bringing up sun and blues. For sunset, the sun is dimmed slightly; reds coming up, blues going down. If the sun and blues are dimmed exactly right and the reds brought up at the proper time, the scene will change from bright sunlight to afternoon haze, then to a beautiful reddish purple and afterwards to a red glow. As it becomes dark, the stars become visible. For the moonlight effect, a little blue is added, and an evening scene is produced that is all that can be desired.

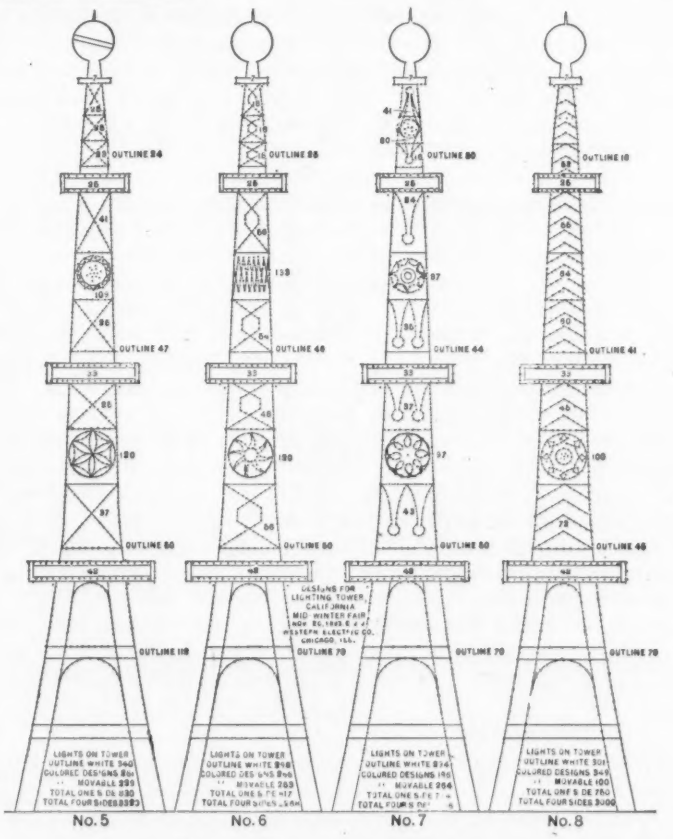


FIG. 1.—ILLUMINATED TOWER.

The curtain is then dropped and the switch on the house lights thrown over, and another day is over.

There are a number of different methods of controlling the rheostats in these theatres. One system has clutches operated by magnets controlled by push buttons; this adds a large amount of apparatus to get out of order, and also heavy first cost. In another

* Extract of a paper read before the Chicago Electrical Association.

method cams are arranged on a shaft to throw in and out all switches, operate the rheostat and all other parts. This is even more complicated and expensive.

Secondly, I will speak of decorative work as applied to tower lighting for advertising or other purposes. The treatment of any tower of course depends on size and location, whether it is to be seen from far or near, in or out of doors. As I had a little experience with one a few years ago, I will use that to illustrate.

This tower was 250 feet tall, 48 feet square at the base. The architect's drawings showed the tower covered with a miscellaneous assortment of designs, using about 8000 lights. As we were limited to 3000 it was necessary to make some change, as 5000 could not be taken off the tower in a lump without it being noticed. The designs which I have here were made in 1893 for this work. It was decided at the outset to use part stationary and part "movable" lights; by movable lights I mean lights to be lighted and put out by automatic switch. The arrangement of lights as shown consists of a row of 16-cp whites up the four corners of the tower, 2 feet apart; cross-bars in white, dividing the tower into nine parts above the first platform, two rows in white around each platform, with a third row of 32-cp reds at the extreme top. The centre division between each platform was used for a movable design in white with a few stationary reds. The upper and lower division had designs of curves in red. The only color that can be used for this class of outside work is red. Blues are not visible, except when used in large numbers and close together, greens are sickly, and nearly all colors are open to their objection.

Discretion should be used in placing all the outline and other stationary lights to utilize the effect to the fullest extent. Place them as far apart as possible, and still retain the effect. By placing the lights close together the large number required brings the cost too high. In works on as large a scale as this tower, outlines and other stationary lights can be placed from 18 to 24 inches apart, and give an effect that is all that can be desired. In movable effects the designer can use all the ingenuity he possesses, and then he will not know, until he sees the operation, whether they are going to be effective or not. In any movable design the idea is to deceive the eye into seeing a moving figure, where there is actually one station-

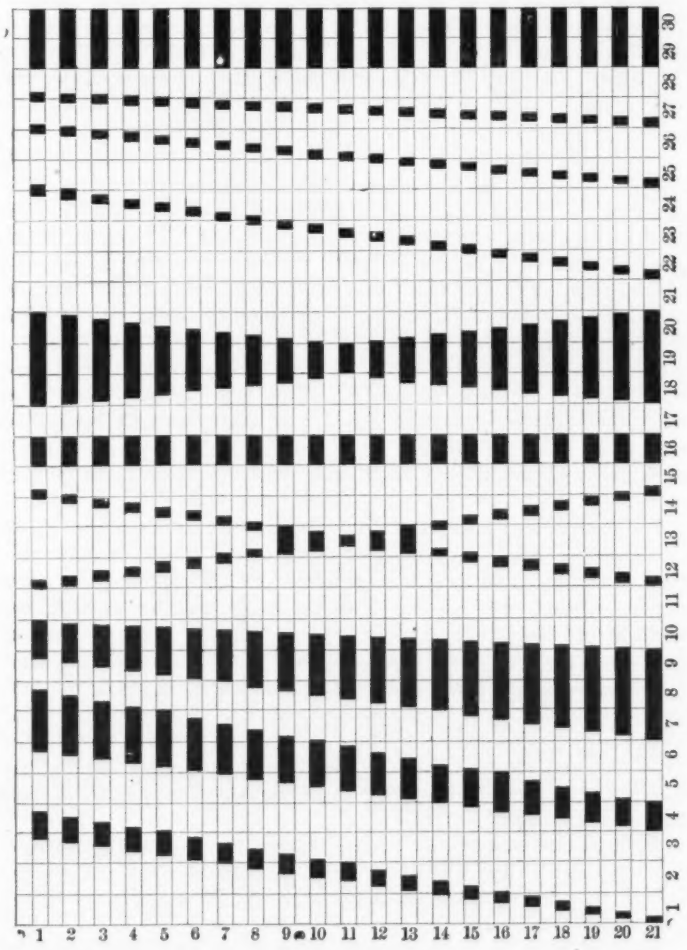


FIG. 2.

ary; not a very easy thing to do. To do this it becomes necessary to light the circuits faster than the eye can follow, or from six to ten per second. This speed depends somewhat on the length of circuits and number of lights. A safe rule is to light as many as six circuits per second. This may seem somewhat rapid to any one who has seen some of the moving designs around the city.

The switch that is used to operate these movable designs consists of a number of discs mounted on a shaft carrying cams on the periphery of each disc. The arrangement of these cams can be shown by a diagram better than otherwise. Fig. 2 shows the periphery of a cylinder unrolled, having 21 circuits. The cylinder is rotated twice per minute so that divisions of the diagram up and down represent seconds. In making this diagram it is necessary to have a clear idea of what you want the design to do. Fig. 2 represents the length of contact cams in seconds. It will be noted that at first the 21 circuits light in three seconds, that the length of cam on the twenty-first is ⅓ of a second, and that circuit No. 1 has a cam one second long. The effect on the design is to have the amount of light constantly increase until the entire design is lighted, as indicated on the diagram when the cams are three seconds long. After coming to the point where the entire design is alight, the entire 21 circuits go out in one second; this is very rapid, in fact, almost a flash around the circle. After this the design is dark one second, then lighted from both ways in three seconds; after this darkness one second, then all 21 circuits light at once, then all go out at once; darkness one second and then they begin to light again from both ways. All are lighted in one second, stay lighted one second, go out in one second, are dark one second; then all light in three seconds, then in two seconds and finally in one second. The lights are dark for one second, then all light at once and stay lighted two seconds. The design then repeats or can be stopped on these cams and remain lighted.

This method of laying out the work of different designs and circuits is very satisfactory, as the exact arrangement can be made, and all cams cut to the required length, without using the old cut and try method. In any scheme of decoration, the idea should be to gradually reach a climax, at which time all the lights should be lighted; unless this can be done the best results are not obtained. In many instances the capacity of the plant will not allow of lighting all the lamps at one time. If such is the case it is much better to reduce the number until they can all be lighted.

On these movable designs I find it good policy to have the cylinder of the automatic switch controlled so as to vary the speed from one to six revolutions per minute. This gives almost endless variety, as the effects change very rapidly as the speed increases. Fig. 3 shows

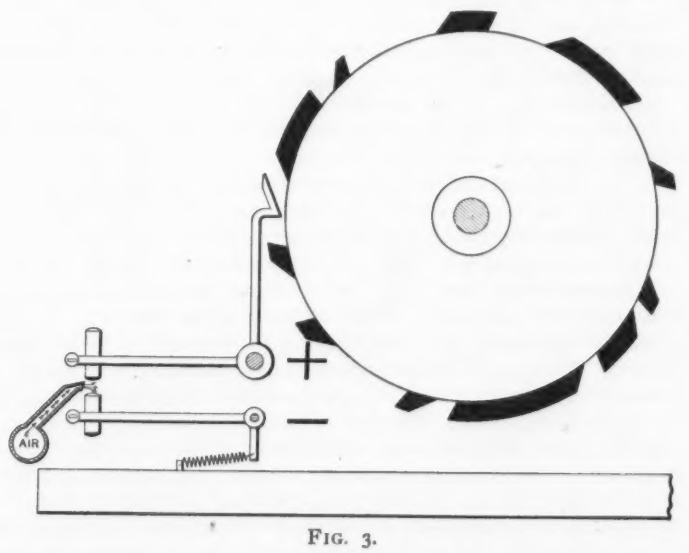


FIG. 3.

one disc with cams of circuits No. 21 in position, with arrangement of breaking the circuit. The cams push out the upper lever, making contact through the carbons. On breaking the circuit the arc would be held across, unless a blow-out were used. The arrangement of the air tubes is shown on the left. A tube with flattened end is placed just where the arc comes. These contacts make excellent arc lights, if the blower is not started.

I wish to enter a protest against the scheme of lighting in use in so many halls and public buildings in Chicago and elsewhere, *viz.*: that of arranging the lights in rows directly in front of the visitor's

eyes, where he is obliged to sit and be blinded by the fearful glare. The Auditorium is a shining example of this scheme.

No method of lighting can be called a success when it causes the amount of suffering that those rows of light do at the Auditorium. In sharp contrast to this, I wish to cite the entrance of the Manhattan Insurance Building in New York. As you enter you are aware that the entrance is well lighted, but you hardly know how. Upon looking up, you apparently see some large openings in the ceiling, covered with ground glass, behind which are the lights. Upon looking more closely, you see that there are hemispherical openings in the ceilings with the lights arranged so that you can get only reflected light. The result is a beautiful clear, soft light, that is a pleasure to the eye and an artistic success.

The Efficiency of Water Wheels.

To the Editor of The Electrical World:

Sir:—Since power transmission from mountain streams to mines, mills and factories situate at distances of many miles has become a matter of daily practice, the subject of water-wheel efficiency has become one of live importance to the electrician. Whatever is contributive to a better understanding of this subject must therefore be considered as progressive information. Of all water wheels the Pelton has proven itself to be best adapted for utilizing the power afforded by the high heads of mountain streams. In fact, the Pelton wheel has been the only one of its peculiar class of free-jet impulse wheels that has found application in connection with electric-power transmission, a fact which is due to the Pelton wheels efficiency, surpassing the efficiency of any other water wheel made or sold up to date. The more pity it is that the manufacturers should have considered it to be in their interest rather to cloud than to clear up the question of its efficiency. "Man merkt die Absicht und wird verstimmt," the German philosopher-poet has said, when unnecessary assertion was indulged in. Why, then, should Mr. Blaue in his communication to The Electrical World, Sept. 12, 1896, repeat the assertion that "86 per cent. be the average efficiency of the Pelton wheel," when it has been demonstrated by incontrovertible calculation based on the very figures as stated by the professors and engineers who set their names to certificates of such efficiencies that the efficiencies so claimed and certified to were, in fact, in excess of those possible to obtain, because they were in excess of the highest possible theoretical power obtainable from the quantity of water stated by them to have been used.

It has been stated that Prof. Reuleaux, of the Polytechnic School of Berlin, had obtained an efficiency of 91 per cent., but upon personal inquiry of the professor, he said: "I have made no experiments with the wheel."

Mr. Blaue quotes 90 per cent. as the efficiency obtained by a test made at the North Star Mine, in Grass Valley, Cal., but fails to give details of the test.

In lurid contrast with his own assertions, Mr. Blaue himself finally arrives, at the end of laborious calculation, at a conclusion which allows to the Pelton wheel an efficiency of but 71.4 per cent.

And, in fact, it is the very method followed by Mr. Blaue in his calculations which deprives them of all or any real value in the matter of determining the actual efficiency of the wheel.

As Thomas H. Huxley expressed it so pertinently: "Mathematics may be compared to a mill of exquisite workmanship which grinds your stuff to any degree of fineness, but nevertheless what you get out depends upon what you put in." The deficiency is with what Mr. Blaue has put into his mathematical mill in the shape of a multitude of unwarranted, assumed coefficients, such as: "Ccefficients of velocity, of discharge, of friction, of design, of nozzle," etc. Mr. Blaue does in consequence not deal with facts which he might claim to have observed himself, but he deals entirely with fictitious values.

What useful knowledge is imparted or expected from a "coefficient of design, some function of $\frac{1-\cos\theta}{2}$" or from a "coefficient of discharge from orifices; the ratio of actual to theoretical quantity of water discharged from the nozzle."

It therefore appears that Mr. Blaue's paper is but a further contribution toward confusing the issue, the efficiency of water wheels of the impulse of free-jet class.

The interest in this issue is made still more acute by the fact that the Pelton water wheel fails to embody all the requisite conditions for highest efficiency but embodies only two minor conditions, which are:

(1) Division of jets in the central plane of rotation.

(2) Inversion of the jet direction at one instant in its rotation, but at an angle which, in the most favorable position occupied at this instant relative to the jet, approximates within 42 degrees of the required 180 degrees.

Two other essential conditions for highest efficiency, namely:

(3) *Absolute* inversion of the jet direction to 180 degrees, and

(4) Permanent inversion to 180 degrees in all positions assumed by the vane relative to the jet are not complied with.

Those who would deny the above statement as to the conditions for highest efficiency would have to controvert, not the undersigned, but such authority as Julius Weisbach's *Mechanics*, in which it is stated in paragraph 526, page 1158, edition of 1875:

"The effect of a water jet depends mainly on the angle at which the water after contact with the vane leaves the same. There is no effect when the angle of exit to the line of approach is zero; but the effect is the maximum, when the angle is such that

$$P = 2\frac{c+v}{g}Qy,$$

viz.: when the angle is 180 degrees, or when the water leaves the vane in the opposite direction to the direction in which it strikes the vane."

And those who would deny the fact that the Pelton wheel discards the water at an angle less than 180 degrees would not only contradict the Pelton patent, but also the very assertion of its manufacturers, which both make it appear that stress is laid on discharging the water while "diverging outwardly."

The highest efficiency of a water wheel coincides with its best circumferential speed, of half the real and not with the jet velocity as Mr. Blaue calculates it. (Compare: Weisbach, page 1160, par. 527, and others.) And it has been understood that the efficiency decreased proportionately as the wheel is over or under loaded, and in consequence varies in speed from the most favorable condition. That probably is also what Mr. Blaue meant to say, but failed to say, because he got mixed somewhat by too lavish a use of coefficients, and by these coefficients distorting unnecessarily his "efficiency curves," of which distortion he feels himself the inconvenience, as shown by his reservation: "If there were no losses of any kind." And the cause of the stated facts relating to the most favorable speed is also known, namely, the other fact that the full force of the jet is not absorbed by the receding vanes, unless such receding takes place at half the natural velocity of the jet. And this natural velocity can only be determined from the quantity of water actually ejected and only by an equation ($V = Q/f$) of which Mr. Blaue seems not to be informed, and which gives such velocity as the ratio of the quantity of water to the area of the nozzle stated in proper units.

The problems of free jet impulse wheels presented to the mathematician are many and of a very interesting nature; but to solve them with practical benefit is possible only by leaving all fundamental conditions unclouded by assumptions and by working with given structural lines and their effects, and by severing from the problem everything not properly a part thereof, such as the causes for differences between head in fact and effective head, the latter being evidenced by water actually ejected. Whatever loss of efficiency may occur before the water strikes the wheel is certainly not to be charged against it. The position taken by Mr. Blaue therefore is a false one, and further investigation of his results is therefore a useless task.

His repeated allusion to water passing the Pelton wheel without touching any of the buckets at excessive speed does not apply to any of the working speeds, unless under very faulty setting of nozzles and scarcely deserved the special discussion it received.

I do not desire to close my criticism of Mr. Blaue's article without making the statement that, notwithstanding the sundry errors committed by professional men of standing in certifying to the efficiencies of water wheels, proof can be rendered for the fact that they worked and certified in good faith. This proof I found in my investigation of the mathematical interpretations used in connection with the Prony brake, an investigation which verified the long suspected fact that the methods of its use now in vogue lead to errors, and I may state here, as I shall prove on a future occasion, that such interpretation may be corrected, so as to render this instrument one capable of giving positive results, while the figures obtained with its aid for nearly 70 years possess a comparative value only.

Hoboken, N. J. F. M. F. Cazin.

Medicinal Properties of Röntgen Rays.

To the Editor of The Electrical World:

SIR:—Thinking that some of the results we have obtained with Röntgen rays may be of interest, we submit the following.

In exhibiting at the State Fair Pavilion in September, Prof. Wilson had the fingers of his left hand in front of a fluoroscope continuously for three hours each evening for two evenings in succession. No noticeable sensation was felt at the time, but in about one week a severe burning sensation was felt in the bones, especially at the joints. The fingers swelled, the joints turned black and an intense inflammation set in, accompanied by excessive pain. By treating them as an ordinary burn immense blisters developed, extending from the nails to the knuckle and covering half the finger in circuit. They then sloughed and by using dry boracic acid he eventually healed them up.

Again, about the 10th of September, Mr. Caffrey mashed his left thumb with a hammer, and, as is the case with such bruises, it pained him excessively. Thinking that possibly the bone had been broken, we made a radiograph of it. Not having any small plates on hand, and having some gelatin films 14 years old we used one of them, and exposed the thumb 30 minutes to the rays in order to be sure of an image on the old film. At the end of that time he was surprised to find that the pain had disappeared, and up to to-day there has been no pain at all in the thumb. Wishing to investigate this subject further, we persuaded a bookkeeper to try the treatment. He was suffering from rheumatism to such an extent that a grain of morphine each night was necessary to enable him to sleep, and for five nights he had not had his clothes off. We exposed the affected hand for one half hour to the rays and that night he slept splendidly, the pain having almost entirely ceased. The next night we again treated him for 30 minutes and the following day he went to work. In a few days the swelling ceased entirely, and since then he has had no return of the rheumatism. The next case was a lady about 50 years old, who had lost the use of the fingers on her left hand, due to rheumatism, the disease being of five months standing. We treated her in precisely the same manner and she immediately recovered the use of her fingers. The next case was a young lady suffering intensely with rheumatism in her elbow. After two treatments she could use her arm. This case was one of inflammatory rheumatism that had existed about one month and the doctor had given it up. In three days the swelling disappeared and the use of the arm was regained. The next person to be treated was the wife of a prominent local physician, who had had rheumatism, centering in the hand, since July last. After a treatment of 30 minutes she could use her hand and has done so ever since. In all these cases except the first we noticed evidences of slight sunburn, but nothing serious resulted therefrom. The next case was a woman about 50 years of age, weighing over 300 pounds, who had injured her knee in getting into a buggy. She had been in bed continuously for nine weeks. We undertook to make a radiograph of the knee. Owing to the immense size of the limb we were at a loss to know the exact time for exposure, but gave the plate an exposure of two hours. This we found to be an over exposure. At the end of this time the lady got up and walked around without assistance, finally walking down a flight of 15 steps to her buggy. Since then (five weeks now) she has had the use of her limb without pain, and apparently is as well as she was before the injury. Her physician was in attendance during the treatment and was nonplussed at the result. The next case was one of bronchitis of 30 years standing. We are still treating this gentleman, and the results so far have been remarkable. For 25 years he had not slept the entire night without waking up almost choked. But after the second treatment he was enabled to sleep all night, and now the pain has ceased entirely, the cough has been reduced over one half, the expectoration is not nearly what it was, and it is quite apparent that the treatment has killed the germs of fermentation, as the expectorated matter has no taste or odor. He can now use his voice immediately upon arising where, heretofore, it was several hours before he could speak above a whisper. His entire demeanor has changed, and he claims to his friends that he is being cured. The next case, and one which we consider the most remarkable, is a physician who came to this town on account of the climate and altitude. He has been suffering for about four years with tubercular consumption, and has used nearly every known remedy. He wanted to try the Röntgen rays, and before treating him we had him send some of his sputum to Cooper Medical College in San Francisco for examination with the result that a large number of bacillæ tuberculosis were reported present. We then treated him for five days in succession, using an eight-inch tube, the time of treatment varying from three-quarters of an hour to an hour. He again sent his sputum for examination, and the following is the answer from Cooper College: "We find bacillæ still present, but they have decreased both in size and number. We congratulate you upon your improvement." After the first treatment he noticed a remarkable change in his general health, and since then he has lost that pallor which is so characteristic in this disease. He has also noticed the absence of fermentation germs since using this treatment, also a marked decrease in the cough and amount of sputum. We are still treating him. In neither of these cases have we been able to detect any indication of sunburn. The next case was little girl brought to Reno from Washoe City, to have a hand amputated. A sore had developed on the back of her hand at the knuckle joint of the third finger, and was continually giving off pus. We made a radiograph of the hand and discovered three pieces of glass lying next to the joint. Owing to the cramped condition of the fingers we were obliged to make a second negative, using a film in the place of a glass plate. Immediately after this treatment she sat upon her father's knee and fell asleep in his arms, not having been able to sleep before for several days. At the end of two weeks her father returned and brought a piece of bone which had sloughed out and reported that the inflammation had entirely disappeared and that the sore had healed over. From the time of the making of the radiograph to the present time she has had no pain.

WILLIAM G. CAFFREY.
NATHANIEL E. WILSON.

RENO, NEV.

[The above communication was received some two months ago, but for obvious reasons was not published. Personal inquiry has, however, led us to believe that Messrs. Wilson and Caffrey are perfectly sincere in their statements. Messrs. Wilson and Caffrey's experiments show that either Röntgen rays or some other phenomenon accompanying them has an exceedingly powerful action, or the subjects upon whom they experimented have been materially benefited, due to an equally powerful mental belief in their efficacy. The above letter is published not for the purpose of creating the hope that Röntgen rays are capable of alleviating human suffering, but with the possibility that some wheat may be sifted from the chaff with which it is considerably imbued.—ED.]

E. M. F. Regulation of Electric Motors.

To the Editor of The Electrical World:

SIR:—I notice that on page 797 of your issue of Dec. 26, 1896, relative to boosters, you have referred to Mr. H. Ward Leonard's patent of Dec. 8 on counter E. M. F. regulation of electric motors, and have in effect given the public to understand that Mr. H. Ward Leonard prevailed over all other contestants in the interferences, and is entitled to the broad invention of the booster system. As such condition is at variance with the actual facts, permit me to explain the situation of the interference, so far as I am concerned, that there may be no misunderstanding. As a matter of fact, my reductions to practice of the broad invention of E. M. F. regulation were prior to the conceptions of Mr. Leonard, and after Mr. Leonard had made propositions to me for an amicable adjustment of the interference, which were declined, he made a motion to dissolve the interference on the ground that the broad invention was not patentable over the prior art. The Primary Examiner dissolved the interference upon this motion, citing a certain patent which anticipated all of the interferents but myself. I did not appeal from the decision, since the record in my case antedated the reference relied upon (my reductions to practice antedating the patent cited, and my completion of the invention being considerably anterior to the reference). Mr. Leonard, realizing the situation, thereupon made a new motion calling attention to the facts, as above stated, and asking that the examiner vacate his decision and deny the patentability upon an earlier reference. This motion was denied. Thereupon Mr. Leonard limited his application to specific details which distinguished it from the particular prior references, and his patent 572,903 issued on Dec. 8, 1896. The broad claims, some 30 or more, remain in my application to be issued as the fundamental patent upon this system. Mr. Leonard's patent will be subservient to mine. Under these circumstances your publication implying that Mr. Leonard has succeeded in overcoming all contestants and secur-

ing the broad claims is evidently based upon a misunderstanding of the true facts.

In this connection I would call attention to German patent No. 59,494, of 1890, granted to Anspach, which shows the identical device of Mr. Leonard's patent filed nearly two years later. The German patent is shown diagrammatically in Fig 1, and is in construction essentially a booster system, while Mr. Leonard's is primarily de-

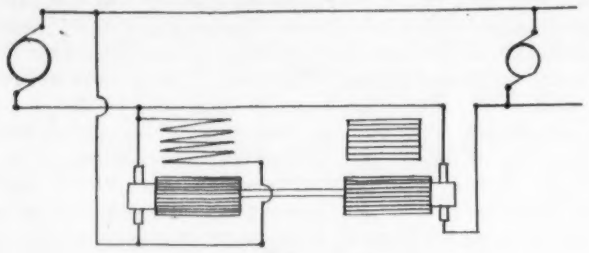


Fig. 1.

signed to reduce the potential for regulating speed of motors. In this German patent the motor generator has one element in parallel across the mains and the other element in series with the translating devices in the main circuits.

Motor generators for producing variations in potential are clearly set out in British patent 200, of 1881.

Thomson's patent, No. 425,470 of 1890, discloses the booster system applied to constant-potential mains, and differs from Leonard only in operating in parallel with the translating devices. Leonard's devices are purely regulating means for motors and designed for car work, and is not properly designated as a booster system. Any differences between Thomson and Leonard are fully shown in the German patent.

Leonard's 23d claim, for example, is exactly readable upon the patent to Rice, No. 396,602, Jan. 22, 1889, filed Oct. 28, 1887. The mere statement that the method claimed is proposed on the multiple-arc distribution system is of no importance, as that does not alter or modify the real method claimed which is fully anticipated by Rice in the exact words.

The British patent 18,784 of 1888 also sets out a construction of booster system in which the substance of Mr. Leonard's structure is found.

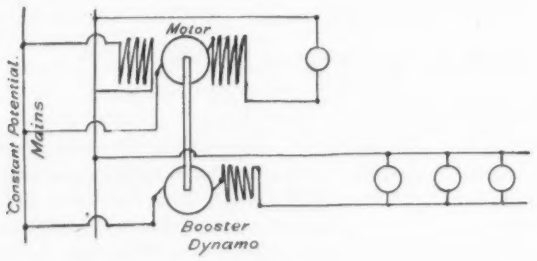


Fig. 2.

He has two machines close together and mechanically connected so that one acts as a motor and the other a dynamo. The motor may be a pure shunt machine. The motor gives power which acts to drive the booster dynamo in the other circuit.

An example of using a booster principle for multiple arc distribution is found in patents 379,218 and 399,219, May 5, 1889 (filed in 1888) to Stilwell and adapted to alternating currents. The only difference from the system of Leonard is due to the difference in current. These patents show lines of constant potential, a boosting potential raising coil (corresponding to the armature of Leonard's boosting generator) in series with the translating device to be affected, and an inducing coil (corresponding to Leonard's field coils of his boosting generator) in parallel with the line and translating device. Mr. Leonard has simply taken the principle of this broad system and applied to it continuous currents in the manner shown by the other prior art.

These several patents upon the state of the prior art for direct current boosters are those which come to my mind at this moment, but there are others,

R. M. Hunter.

Philadelphia, Pa.

To the Editor of The Electrical World:

Sir:—I have read Mr. Hunter's letter to you in which he endeavors to show that if there is anything of value in my patent, No. 572,903, of Dec. 8, 1896, he is entitled to it, and that if by any chance any part of it escapes him, such part has no value anyhow because of the prior art.

Mr, Hunter's letter represents the sour grapes of a long complex interference involving nine different contestants, of whom Mr. Hunter was one, and I need hardly say that such value as my patent may have is not likely to be affected by his present childish scoldings.

The patents mentioned by Mr. Hunter were of course well known to the Patent Office when it granted my patent, and my patent was only allowed after it was clear that my claims were free from Mr. Hunter's references and dozens of others, or else that my date of conception enabled me to ante-date the references.

Mr. Hunter threatens: "Mr. Leonard's patent will be subservient to mine."

I think it will be time enough to discuss that question when Mr. Hunter succeeds in getting such a patent as he says he will get.

Every interference between Mr. Hunter and myself which the Patent Office decided, was decided in my favor, and at present no interference exists between us. If I have the misfortune to get into another interference with Mr. Hunter I shall be pleased to discuss the results with him at the proper time; that is, after the Patent Office has issued a patent to the party which it has decided to be the true first inventor.

H. Ward Leonard.

Hoboken, N. J.

The Effect of Pressure Upon the Temperature of the Arc.

Some months ago a Mr. Wilson read a paper before the Royal Society in which he made the startling announcement that the effect of increasing the pressure upon the electric arc was to decrease its temperature, a decrease in temperature which was so marked as to make the arc *red* hot when the pressure had been decreased to a few atmospheres. Our London correspondent informs us that at the last meeting of the Royal Society a paper on the same subject was read by Mr. Wilson and Prof. G. F. Fitzgerald, in which they announced that the original paper was completely erroneous. Mr. Wilson surrounded the arc in the first instance with nitrogen gas, and the nitrogen not being chemically pure, containing a large quantity of oxygen, the result was that with a very small pressure NO_2 gas was freely given off, and naturally the arc, when looked at through this appeared red. While thus admitting a grave error in the first instance, Prof. Fitzgerald raises the point that the results now obtained do not afford complete satisfaction to those who hold to the belief that the temperature of the arc is constant because it is the temperature of volatilization of carbon. He points out that either the latent heat of volatilization of carbon must be something absolutely undreamt of, judging by the watts consumed in the electric arc, or its rate of volatilization must be extreme, which it is easily shown is not the case. He further points out that from a theoretical consideration one would expect the temperature of the arc to be raised by 270° C for every increase of one atmosphere in pressure, so that at 17 atmospheres the electric arc would attain the temperature of the sun. It is needless to say that the experimenters on raising the pressure to this point, indeed to a considerably higher point, found that they had not attained the temperature of the sun.

Prizes for the Advancement of Science.

By the provisions of the will of the late Alfred Nobel, Swedish engineer and chemist, who died recently, a fund will be established for the advancement of science, and the interest on the money will be equally divided into five prizes, to be awarded annually. Three of the prizes will be for the greatest discovery in physics, the greatest discovery in chemistry and the greatest discovery in physiology or medicine; the fourth prize will be awarded for the most notable literary contribution on physiology or medicine, and the fifth for the greatest achievement for the promotion of peace. Competition for these prizes will be open to the world. According to a dispatch from Stockholm the fund will amount to nearly $10,000,000.

Röntgen Rays and the Blind.

In referring to the recent newspaper reports about Mr. Edison's experiments, the London *Electrician* remarks as follows: "Mr. Edison, whether he relies upon the alleged curative properties of these rays, or whether he is misled by the fallacious argument to which we have referred, need be in no hurry to forestall European experiments with X-rays by restoring sight to the sightless. He may expect to succeed in this when he has given warmth and life and animation to a wooden leg."

DIGEST OF CURRENT TECHNICAL ELECTRICAL ARTICLES COMPILED FROM FOREIGN AND AMERICAN JOURNALS

BY

CARL HERING

DYNAMOS, MOTORS AND TRANSFORMERS.

Calculation of Dynamos. ARNOLD. *Elek. Zeit.*, Dec. 17; The conclusion of his article (see *Digest*, Dec. 19).—Among other things he shows that the law of the parallelogram can be applied to the combination of the E. M. Fs. only when the parts of the circuit in which the different E. M. Fs. are induced are magnetically independent of each other, or if this condition is not fulfilled, then only as long as the magnetization curve is a straight line. He applies the short-circuiting method to the examination and calculation of continuous-current machines, and shows among other things that the amount of armature reaction can be determined for each position of the brushes by a measurement of the short-circuiting current. He gives a method for predetermining continuous current and all kinds of alternating-current dynamos, the method being the one which he uses. The article does not admit of being abstracted.

Shunt Winding of Dynamos.—Lond. *Elec. Rev.*, Dec. 18.—A short communication referring to the recent articles by Kennedy (see *Digest* last week). The writer believes that the method described for determining the wire for the coils is needlessly lengthy and not quite to the point, and he prefers to determine first the size of the wire, after which the length, resistance and number of turns for any given current density can be obtained by reference to a wire table and a simple proportion; he includes formulas giving what he calls the most usual method; it is necessary to remember that the voltage, being constant, the ampere-turns will depend only on the average resistance of the wire per turn, and for the same average length per turn they are independent of the number of turns.

LIGHTS AND LIGHTING.

Ultra Incandescent Lamp.—Lond. *Elec.*, Dec. 18.—A note taken from a French journal referring to experiments by Baliasnyg with a view to utilizing in the electric lamp the radiative powers of the oxides of the yttrium earths (like those in the Welsbach mantles). The core of the incandescent body is made of strips of asbestos card; this is dipped in a solution of 30 per cent. of chloride of platinum, then in a saturated solution of chloride of ammonium; after drying it is burned, leaving the platinized asbestos; this is immersed in a saturated solution of chloride of magnesia, dried and again burned, the platinizing and covering with magnesia being repeated several times until a layer 0.06 to 0.08 inch is obtained; after these preparations the filament is immersed in solutions of nitrate of thoria, ceria or zirconia and again burned off, after which it has the properties of a Welsbach mantle and is mounted in the vacuum tube like an ordinary incandescent electric light; the surface of the strip is larger and more luminous so that with the same expenditure of current this lamp is claimed to give 15 times as much light as the ordinary incandescent lamp.

Transition of Carbon from the Non-Conducting to the Conducting State. BRION. *Weid. Ann.*, No. 12; noticed briefly in Lond. *Elec.*, Dec. 18.—He experimented with paper, bamboo and cellulose; the resistance was found to be a function of the highest temperature to which they had been subjected and of the time which had since elapsed; for bamboo and cellulose the lowest resistance was nearly reached at 820 degrees C., there being little change after that; on cooling it increased, attaining two or three times the original value in 24 hours; the residual conductivity which remains after cooling depends on the highest temperature attained.

POWER.

Electric Ploughs.—Lond. *Elec. Rev.*, Dec. 18.—An abstract of the article noticed in the *Digest*, Sept. 5, including some of the working data.

Elevator.—Sc. Am., Jan. 2.—An illustrated description of a system of electric elevators in which a windlass is used, driven by an electric motor, through the medium of a worm gear.

Use of Electric Power. BELL. *Eng. Mag.*, January.—An article on the "Wonderful Expansion in the Use of Electric Power," in which he begins with a historical summary, and describes briefly some prominent power installations in this country. Regarding the future he believes that the growth will be along two lines, there will be an enormous extension in electric railway work, and an immense development of the natural power resources of the country; he remarks that there are unemployed water powers enough within 50 miles of New York to displace every steam engine in the city, at a profit.

Power for Centrifugal Fans.—Amer. Mach., Dec. 31.—Two tables giving the power required for fans, over a considerable range of pressure of blast, and various degrees of opening of the outlet; they are believed to be the first tables of the kind published.

TRACTION.

Combined Lighting and Traction Plants. SPENCE. Lond. *Lightning*, Dec. 17.—A short article suggesting what he considers a better system for the combination of the two plants than those summarized in the recent article by Rider (see *Digest*, Dec. 26). It is extremely desirable that a single type of generator be adopted, and he endeavors to show that, whether the lighting plant be alternating or continuous, the same machines are readily adapted to traction purposes. He speaks favorably of rotary transformers which have been in very satisfactory operation at Geneva and which give no trouble with sparking; he claims that the ratio of the alternating to the continuous voltages is not a fixed quantity, as a considerable range can be obtained on the direct-current side by merely varying the field strength so as to control the phase relation; there is therefore a possibility of a certain amount of automatic regulation by compounding; a much better plan is to partially separate the two windings on the armature so that an independent field control may be obtained from one of them, thus enabling considerable variations to be obtained; the same machine could then feed the trolley wire or charge the batteries at a 30 per cent. excess of voltage. The combined system which he suggests is referred to in the latter part of the articles and seems to involve the use of continuous-current apparatus throughout, being a modification of the Oxford system in which the (rotary) transformers act mostly only as reducers, that is, they will have a single armature with two windings and commutators with a ratio of about one to one in series; at the power house all the generators would have 1000 volts from the two armature windings in series; the negative pole would be earthed and all the machines would be in parallel; for the trolley wire the first commutator would be tapped at the intermediate brush for a 500-volt current; for the distant lines it would be transmitted at 1000 volts and reduced in sub-station to 500; for neighboring lighting a two-wire system at 220 volts would be used in connection with the 500-volt current, suitably reduced; beyond 1.5 miles the lighting supply would be on the three-wire system, with 220-volt lamps, and the currents for this would be electrically distinct from the other systems, thus enabling the middle wire to be earthed; storage batteries would be used for each service, preferably in sub-stations.

Continuous Rails.—Lond. *Elec.*, Dec. 18.—An editorial discussion of the subject concluding with the opinion that while continuous rails may be satisfactory and practical in America, they do not have much chance of being extensively adopted in England, no matter by what system they are joined; the reasons are that in England a low-grade rail is used, which is better suited to the English conditions than higher grades; these rails do not have such stiffness and elastic strength as those commonly used in America, while their coefficient of expansion is appreciably greater.

Closed Conduit. CIRLA system. Lond. *Elec.*, Dec. 25.—An illustrated description; on the surface of the street there are small contact-making pieces 16 to 17 feet apart, from which current is taken by a long contact bar carried underneath the car; the contact pieces are put into connection with the feed wire beneath them by a magnet carried on the car; the contact is made by a soft iron disc which is connected with a flexible cable to the feed wire and is raised so as to come into contact with the bronze cover of the box; the whole moving mechanism is enclosed in a glass vessel which is kept water tight. To get over the difficulty of carrying a battery he uses hardened steel for his magnets, which have sufficient power to operate the contact; the ordinary air gap is only about two inches and only 130 to 150 watts are said to be required for the magnets; the contact piece carried by the car is flexible.

Liverpool Overhead Railway.—Lond. *Elec.*, Dec. 25.—An underground extension of this line, three fourths of a mile long, has just been opened to the public.

Proposed Rapid Transit Plan for City Streets. AIMS system. *Eng. News*, Dec. 24.—A brief, illustrated description of this system, in which it is proposed to have a double-track express service in a tunnel directly beneath the surface of the street, and a local service to carry passengers to the express stations, on the surface directly above, the conductors for which are in a conduit which forms the top of the tunnel, and is therefore accessible from beneath and can never be filled with water,

thus overcoming all the difficulties with regard to drainage. Editorially it is thought that in New York City, where the distances are very great and the streets too crowded, to rely on surface traction to carry passengers to the express stations would rob the express service of a large part of its efficiency, but in cities where the distances are less it is thought that the system is excellently adapted.

Power Station Test.— Tech. Quart., December.—The results of a detailed test made by students of one of the West End power stations in Charlestown, Mass.; it is limited almost entirely to tests of the boilers and engines; the tests are quite elaborate, and the data is given in numerous tables.

Single-Wire, Double-Track System.—Elec. Eng., Dec. 30.—A brief illustrated description of the Henry system, in which there is only one trolley wire between the two tracks of a double track line, the trolley arms being horizontal and having a vertical contact bar, which slides along the wire; the trolley wire is suspended from wires going diagonally across the street from one pole to the other, making a very small angle with the line of the trolley wire, thus dispensing with one half of the poles used in the usual system.

Economy of Car Heaters.— West. Elec., Dec. 26.—The results of tests recently made on a Chicago line, in which the electric system of heating shows an actual economy; the cars can be maintained at a very comfortable temperature for less than one cent per car-hour; all the cars are electrically heated; the current is produced at less than one quarter of a cent per kilowatt-hour for fuel; in the cost of the electric heat it is assumed that the only item which is increased by the use of the heaters is the cost of the fuel.

European Railway Statistics.—Cassier's Mag., Jan.—A brief table of statistics giving the length, power and number of cars taken from a recent United States Consular report.

Electric Railways in the United Kingdom.—St. Ry. Jour., Jan.—A complete list of those in operation and under construction at the present time, with some brief tabular data.

Mechanical Traction in Europe. Ziffer. *St. Ry. Jour.*, Jan.—A long translation in abstract of the article noticed in the *Digest*, Dec. 12 and Jan. 2.

Electric Subways in Brooklyn.—St. Ry. Jour., Jan.—An abstract of the report of the Bureau of Commissioners, giving in full the report of Barrett, which was abstracted in the *Digest*, Dec. 19, including the map which was not published in the reprint noticed at that time.

British Impressions of American Street Railways. McCallum. *St. Ry. Jour.*, Jan.—A short article giving favorable impressions.

Operation of Power Stations. Tandy. *St. Ry. Jour.*, Jan.—An article giving comparative tubular data for a number of different kinds of power stations for electric railways.

Washington, Alexandria & Mt. Vernon Railway. St. Ry. Jour., Jan.—A long, well-illustrated description of this line in which there is a combination of an underground and a trolley system, and on which high speed is attained; there are also a number of novel features in the station, track and line construction.

Street Railway System of Paris. Lavalard. *St. Ry. Jour.*, Jan.—The first installment of a series of articles on the street railway systems almost all of which are not electrical.

Chicago.— West Elec., Dec. 26.—A brief illustrated description of the new equipment of the South Chicago Street Railway Company, which is claimed to have resulted in a quite remarkable fuel economy; it comprises 52 miles of road with 40 cars.

Toledo.—St. Ry. Jour., Jan.—An illustrated description of this plant which comprises all the street railways in that city, embracing 120 miles of single track; the power house also supplies currents for lighting.

Norfolk.—St. Ry. Jour., Jan.—A brief description of the interurban passenger and freight railway from Norfolk to Ocean View.

Richmond.—Elec. Eng., Dec. 30; *St. Ry. Jour.*, Jan.—A brief illustrated description of the railway system in Richmond, Va.

Owosso.—St. Ry. Jour., Jan.—A brief illustrated description of this plant in Michigan, furnishing both light and power.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Penny-in-the-Slot Meters. Gibbings. Lond. *Lightning*, Dec. 17.—A short article pointing out the advantages of the use of such prepayment meters. The consumer using such a meter has absolute means of knowing exactly what expenditure he is incurring; the chief advantage is the inducement which this method holds out to the small householder and tradesman for whom a quarterly bill would be too burdensome; at 10 cents per kilowatt-hour a 3.5 watt, 8-cp candle will remain lighted for over seven hours for 1 English penny (2 cents), which he believes will be perfectly satisfactory to the consumer; such a consumer demands but a small maximum supply for a large number of units, and is therefore one that ought to be encouraged by the station, as it is such consumers who increase the earning capacity of the plant.

Thermic Interrupter.—L'Eclairage Elec., Dec. 19.—A brief, illustrated description of the Iglesias system, which is intended to prevent more than a certain number of lights to be used on a circuit, as in cases in which the current is paid for by the number of lights instead of by the meter. The apparatus is connected in series with the lamps, the current passing through a stretched wire which holds a carbon point in contact with a disc covered with tinfoil; when the wire becomes heated, due to too large a current, this contact is interrupted, and as the tinfoil is thereby burned away, the contact will not be re-established, until the disc is turned by hand by the proper authority.

Free Lamps. Hancock. Lond. *Elec. Rev.*, Dec. 18.—Another communication on this subject (see *Digest*, last week). He points out the great desirability of the disappearance of low-grade lamps, stating that this could be controlled much better by the supply companies than by anybody else, by adopting some such method as that introduced at Bradford.

Chester, England.—Lond. *Elec. Eng.*, Dec. 18.—A very long illustrated description of this plant, which is said to be unique in several respects; the three-wire system fed by feeders is used, the voltage in the houses being 210; the means for regulating the supply by a battery and balancing it by a continuous-current transformer is said to be novel in some respects; the contractors are entirely responsible for the working of the station and the paying of all expenses, the station being handed over to the corporation after three years, the corporation meanwhile guaranteeing certain demands and paying the directors in a decreasing ratio as this demand is exceeded; applications have been made for 8000 lamps of eight candle-power.

Chalfont.—Lond. *Elec. Rev.*, Dec. 18.—A brief description of this small plant in which petroleum engines were used on account of the great distances from a railway station; the engine develops 11 horse-power, and is guaranteed to consume only 1.25 pints of oil per horse-power per hour; accumulators are used in connection with the plant; the petroleum is delivered at 12 cents per gallon and the cost of the electricity per unit used is about 8.5 cents, including wages but not depreciation; when the plant was run on trial with a full load the cost was 6.5 cents per unit.

Croydon.—Lond. *Elec.*, Dec. 18.—A brief illustrated description of this station; more complete descriptions were referred to in the *Digest* some weeks ago.

Cologne.— Elek. Anz., Dec. 13.—Extracts from a report of the operation of this station for the year ending March, 1896; the extracts include quite a number of tables of operating data.

Installations in Switzerland. Blondin. *L'Eclairage Elec.*, Dec. 19.—A continuation of the series of articles, the present one giving brief descriptions of a few more of the installations.

Brooklyn.—Eng. News, Dec. 24.—A note stating that a large Edison station is to be erected in Brooklyn along the water front at Sixty-sixth Street, and it is the intention to make this one of the largest and most economically operated plants of its kind in the world; attention is called to the economies resulting from the location of such a plant on tide water, both on account of the use of condensing water by which a saving of one fourth to one third in fuel can be made, and in receiving coal by water instead of by rail.

Private Plant.—Elec. Eng., Dec. 30.—An illustrated description of the plant at the Royal Poinciana hotel, Florida, having a capacity of 9000 lights; the alternating-current system is used, the alternators being operated in parallel; the switchboard is arranged to connect the machines in the most economical way with reference to load changes.

Fuse Block and Lightning Arrester Tests at Niagara Falls. Elec. Rev., Dec. 30.—A reproduction of some photographs, together with a very brief explanation of some tests recently made. In one of these four Westinghouse fuse blocks of the "sneezer" type were connected in series across the 10,000-volt mains, short-circuiting a 5000-hp dynamo; the photograph shows the paths of the drops of molten metal thrown out by the blocks. In another a General Electric lightning arrester was similarly connected, the current being started by an induction coil. Another test was made with some Wurtz lightning arresters.

Lincoln Park Lighting.— West. Elec., Jan. 2.—A brief illustrated description of the plant for lighting this park in Chicago with 243 arcs; the boilers are used for both the lighting and the pumping plant.

Nice.— West. Elec., Dec. 26.—An abstract, with the illustrations, of the descriptive article noticed in the *Digest*, Nov. 7.

WIRES, WIRING AND CONDUITS.

Theory of the Wiring Table. Grier. *West. Elec.*, Jan. 2.—A brief, elementary explanation of wiring calculations and tables, containing, however, nothing new.

ELECTRO-PHYSICS AND MAGNETISM.

Dielectric Constant of Liquid Oxygen and Air. Fleming and Dewar. Lond. *Elec.*, Dec. 25; an abstract of a Royal Society paper describing and giving the results of recent determinations.—Liquid oxygen has exceedingly high insulating properties, and therefore possesses a dielectric constant. The method used consists in the employment of a small condenser of mica, which is plunged into the liquid gases and its capacity measured when in the liquid and in the air; for determining the capacity the condenser was charged 10 times in succession, being discharged each time into a much larger one. They obtained the value, 1.491, as the dielectric

constant, as compared with that of the gas directly beneath the liquid; this number is one of the smallest obtained for any solid or liquid dielectric. Liquid oxygen obeys Maxwell's law very closely. For liquid air the number was 1.495. In an addendum they show that the ratio of the density of liquid oxygen to that of gaseous oxygen is 849 to 1, from which it follows that the magnetic susceptibility of liquid oxygen is nearly twice as great as that of the gaseous oxygen for equal masses; the inference is that magnetic susceptibility is not merely a property of the molecule *per se*, but is a function of the state of aggregation.

Distortion of Alternating-Current Waves. EISLER and REITHOFFER. *Elek. Zeit.*, Dec. 17; the conclusion of their article (see *Digest* last week).—They give an experimental demonstration of the statement made in the first part of the article; a diagram of the connections is given as also the current curves; in this test the primary current of the transformer was generated by an alternator in series with a battery of accumulators. The curves prove the correctness of the theory; the current curve had an appreciably higher positive than negative maximum but the duration of the positive period was shorter than that of the negative, the result being such that there was no excess of electricity in one of the two directions. In conclusion they show an important difference between a result which they obtained and that obtained from the Steinmetz hysteresis formula.

X-Rays and Blindness. ROBERTSON. Lond. *Elec.*, Dec. 25.—A short communication describing some recent experiments made on him by Mr. Jackson; in his case blindness is the result of atrophy of the optic nerve, but the nerve is not quite dead and the eye is healthy and normal. The only sensation felt was a pulsation in one of the eyes; there was no sensation of light; the pulsation increased as the tube was approached to the eye; no alteration was made in the effect, by interposing black paper, but a metal screen stopped the pulsation; the spark at the contact break produced more sensation of light than did the unscreened focus tube; no sensation of light was produced by the Röntgen rays.

Röntgen Rays. MACINTYRE. *Amer. Jour of Sc.*, January; a brief abstract from *Nature*, Nov. 18.—He obtained lantern slides of X-ray photographs by focusing the shadow produced on the fluorescent screen onto the ground glass screen of an ordinary camera. He found that quite a number of X-rays pass through the screen and are therefore not utilized; for this reason he uses a large and thick screen in which the crystals are very much coarser.

Types of X-Ray Tubes. *Elec. Eng.*, Dec. 30.—A reprint of the illustration of 32 tubes mentioned in the *Digest*, Dec. 12.

Röntgen Rays and Diseases of the Heart. H. C. THOMSON. *Elec. Rev.*, Dec. 30; reprinted from the Lond. *Lancet*.—A brief description with illustrations describing the appearance of the heart and its actions, as seen with the aid of Röntgen rays.

Magnetic Permeability of Liquid Oxygen and Air. FLEMING and DEWAR. *El'ty*, Jan. 6.—The beginning of a reprint of the article abstracted in the *Digest*, Jan. 2.

Residual Photoelectric Effect of Cathode Rays. ELSTER and GEITEL. *El'ty*, Jan. 6.—A reprint of the article noticed in the *Digest*, Dec. 26.

ELECTRO-CHEMISTRY AND BATTERIES.

Chlorine and Alkalies. KELLNER process. *Zeit. f. Electrochemie*, Dec. 20.—A brief abstract of a recent patent for the production of chlorate of potassium. The electrolyte is a cold solution of chloride of potassium to which is added enough calcium hydroxide (about 3 per cent.), so that the greater part is undissolved and remains suspended in the liquid by constant stirring; the chloride of calcium formed takes part in the decomposition, developing chlorine at the anode and calcium at the cathode which combines with the water and forms the original material again; the part taken by this material is that it carries the oxygen to the chloride of potassium without taking part in the electrolysis itself; the loss of the current due to the decomposition of the water is thereby prevented.

This is followed by a brief abstract of the German patent to the Schuckert Company for the addition of carbonates of the alkaline earths to the solution used in their process.

Alkalies and Bleach. KELLNER process. *Zeit. f. Elek.*, Dec. 15.—A summary with illustrations of the various processes patented by Kellner, the article being contributed by the Siemens & Halske Company. The introduction claims that up to the present time none of the methods which have been proposed have been introduced on a large scale in practice, the reason being that the apparatus is too complicated and depreciates too rapidly; in the Kellner processes, however, the problem is claimed to have been solved. The processes described are to meet the different requirements occurring in practice, that is, whether the bleach is to be used directly or is to be in a portable form, etc.

Electricity in Chemical and Metallurgical Industries. KERSHAW. Lond. *Elec.*, Dec. 25.—The first of a series of articles in which he intends to show how far electricity has already been adopted for such operations, limiting himself to the industrial applications, up to the end of the year 1896. In the present portion he discusses the question of the power supply, giving a table of the installations of this kind in which water-power is used, with data showing the amount of power, name of company, products and process. Besides these, there are 41 other installations using steam-power, and four or five which will shortly be started with steam; the steam horse-power probably does not greatly exceed the 32,000-hp water-power used by the 21 factories enumerated in the table. With cheap fuels, continuous working and the best engines, he shows that the cost of an electrical hp-hour would probably amount to ½d. (0.28 cent), which shows that for processes consuming less than 5000 horse-power there is still a possibility of profits in a country possessing cheap fuel but no water-power.

Uranium. MOISSAN. Lond. *Elec.*, Dec. 25; a translation in abstract of a recent article.—He describes the preparation of uranium in the electric furnace in which the oxides are reduced by means of carbon; also the electrolytic preparation of the metal from the fused double chloride of uranium and sodium which can be electrolyzed with great facility, yielding spongy deposits of the metal; the bath is kept fused by the calorific action of the current. The physical properties of the metal are given.

Primary Battery. SICARD and FALLE battery. *L'Eclairage Elec.*, Dec. 19.—A brief description of their primary battery intended apparently for open-circuit work. The retaining cell is of zinc and forms the negative electrode; a mixture of carbon, alum, sulphuric acid and bichromate of potash "forms the positive electrode"; the electrolyte is a solution of chloride of sodium containing 80 grammes of salt per litre; the E. M. F. is 2.03 volts. A current curve is given for a test in which the cell was short-circuited for 20 days; besides its high voltage the advantages claimed are that there are no creeping salts.

Polarization in Batteries. IHLE. Lond. *Elec. Rev.*, Dec. 18; a brief extract from one of the German journals.—He found that if the nitric acid in a Grove cell is gradually diluted with water, the E. M. F. remains nearly constant until the solution contains 38 per cent. of nitric acid, but on further dilution it falls from 1.8 to 0.7, the latter being for 28 per cent.; if, however, potassium nitrate is added to the latter solution, the voltage rises again to 1.8, but falls again to 0.7 as soon as the nitrous acid is destroyed; the voltage for the 38 per cent. solution is lowered by the addition of potassium permanganate or of carbamide; it therefore follows that nitrous acid is the real depolarizer in the Grove cell.

Accumulator. GUYE. Lond. *Elec. Rev.*, Dec. 18.—A translation of his description of the Swiss accumulator, shown at the Geneva exhibition and mentioned in the *Digest*, Nov. 21.

Theory of the Current Following Polarization. E. SALOMON. *Zeit. f. Electrochemie*, Dec. 20.—If a solution is electrolyzed between two electrodes which polarize, the E. M. F. being lower than that required for decomposition, then the counter E. M. F. of polarization will not reduce the current completely to zero; he discusses the theory of this residual current and gives experimental and calculated results, which agree well with each other.

Jacques Cell. ANTHONY. *Elec. Eng.*, Dec. 30.—A short communication regarding the definition of the word thermo-electric, in which he expresses the opinion that the action of the Jacques cell does not differ from that of any other electrolytic cell; the fact that it must be raised to a certain temperature makes no difference in the theory and its action, but simply means that at ordinary temperatures there is no oxidation of the carbon; it is precisely similar to the action in the zinc-platinum cell at ordinary temperatures; very possibly, at a sufficiently low temperature, zinc would not oxidize, and at that temperature there would therefore be no voltage, but on raising it to the point where the zinc would be attacked, current would be generated; there is nothing in this section which could be called thermo-electric.

Formation of Persulphuric Acid. ELBS and SCHOENHERR. *Am. Jour. of Sc.*, Jan.—An abstract of their recent papers which were noticed in the *Digest* some time ago.

Polarization and Internal Resistance of a Galvanic Cell. MOORE and CARPENTER. *Phys. Rev.*, January-February.—A short article in which they give the results of an investigation to localize the polarization. A Leclanché cell without a depolarizer, that is, with simple carbon rods, was used, and in addition to the usual electrodes there was a special carbon rod near the one of zinc, the E. M. F. being measured on closed and open circuits between the regular electrodes and between each and the special carbon electrode, a condenser being used so as not to involve any polarization of the special electrode. Their conclusions are that a variation in the cathode resistance with the current strength does not account for the difference in internal resistance noted in this experiment; polarization occurs at both electrodes, but is more marked at the carbon electrode; on closing the circuit the rapid fall of E. M. F. is due principally to polarization at the carbon electrode; the rapid rise in E. M. F., when a cell is first thrown upon open circuit, is largely due to the recovery from polarization at the zinc electrode.

Formation of Lead Sulphate in Alternating-Current Electrolysis. SHELDON and WATERMAN. *Phys. Rev.*, January-February.—In endeavoring to make an electrolytic condenser with lead electrodes in sulphuric acid they obtained negative results and found that the electrodes were dis

solved, forming lead sulphate. In the present short article they give the results of an investigation concerning the causes; there are three things which influence the quantity of lead dissolved per coulomb, namely, the current density, the frequency and the temperature. They offer no theory explaining the results, but the facts are unquestionably associated in some manner with the velocities or rates at which the chemical process takes place.

Electric Deposition of Carbon.—Jour. Amer. Chem. Soc., 18, page 654.—In an article on the electrolytic determination of iron, nickel and zinc Messrs. Nicholson and Avery found that in the presence of ammonium tartrate an electrolytic deposit of iron always contains some carbon, the amount increasing with the amount of free ammonia and the strength of the current; carbon was also deposited with the iron from solutions containing sugar, alcohol, the salts of acetic and some organic acids.

Oxidation of Sulphides to Sulphates. Durkee. *Tech. Quart.*, December; abstracted from *Amer. Chem. Jour.*, 18, page 525.—With carbon or copper electrodes no sulphide was produced from ammonia sulphide or hydro-sulphide, but with platinum electrodes considerable sulphate was produced; with sodium hydro-sulphide there was complete oxidation.

Conductivity of Solutions of Acetylene. Jones. *Amer. Chem. Jour.*, 18, page 623.—He found that the high electrical conductivity of aqueous solutions observed by Jones and Allen was probably due to ammonia as an impurity and that a pure acetylene solution has a very slight, if any, conducting power.

Electrolytic Refining of Copper. Ulke. *El'ty*, Jan. 6.—A reprint of the article noticed in the *Digest*, Nov. 28.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Ampere Standard. Janet. Lond. *Elec.*, Dec. 25.—A translation in abstract with the illustration and the formulas of that portion of the article noticed in the *Digest*, Dec. 26, which referred to the Pellat standard. In an editorial criticism of this instrument it is stated that it is particularly susceptible to stray magnetic fields; the accuracy of the measurement depends on the absolute constancy of the current and on the value of the horizontal component of the earth's field; a current indicator is therefore necessary, and the efficiency depends on the sensitiveness of this indicator; there will be variations in the measurements due to changes in both the strength and the direction of the magnetic field; this refers only to using the instrument as a secondary standard, considered as an absolute standard; other and perhaps more serious criticisms might be made.

Long-Scale Measuring Instruments.—Lond. *Elec.*, Dec. 25.—A brief, illustrated description of a new pattern of commercial instruments of the rotating coil type, differing from the usual kind in that there is only a single air gap in which only one side of the coil moves, the rectangular coil therefore rotating around one of its sides; the greatest advantage of this is the great range of deflection which is obtained, amounting to 220 or 280 degrees, and the other advantage is the increased stability of the magnetic circuit for a given mass of steel; the scale is usually uniformly divided, but the nature of the division is well under control and can be varied as desired; the deflecting force is the same in all the instruments and for the maximum deflection is nearly half a gram-centimetre.

Measurement of Temperature. Clark. Lond. *Elec.*, Dec. 18.—A continuation of his serial (see *Digest*, Dec. 26). He discusses the general subject of temperature measurement with special reference to thermometers, pointing out the fact that it is not direct but merely a measurement of expansion, thus requiring the curve of relationship between the two quantities; he then begins the discussion of the electrical methods by giving a summary of their development. In the issue of Dec. 25 he discusses the limits of accuracy in these measurements, and gives a large table of 12 "freezing" points and seven boiling points in a range of 1350 degrees.

Localizing Faults in Submarine Cables. Cann. Lond. *Elec. Rev.*, Dec. 18.—An article accompanied by quite a large amount of tabulated data showing the advantages of his simplified formula over the one proposed by Kennelly, first published in 1887, for localizing a complete fracture by a bridge measurement to an instrument zero; when testing from one end of a cable, there measurements of the resistance of the cable conductor through the fault, with different strengths of current, are required; the present author then shows how the formula for this method may be simplified, the correctness of his formula having been proved by the results of many experimental faults tested under very widely differing conditions; a table is given for facilitating the testing.

Determining the Temperature in Vacuum Tubes. Wood. Lond. *Elec.*, Dec. 25.—The first part of a translation, with illustrations of an article, from the *Wied. Ann.*, 59, page 238.

Determining the Capacity of Polarization. Gordon. *L'Elec.*, Dec. 19.—A translation into French of the German article noticed in the *Digest*, Nov. 21.

Condensers. Armagnat. *L'Eclairage Elec.*, Dec. 19.—The beginning of a general article on condensers, forming a sort of brief treatise on the subject.

Seismograph at the United States Weather Bureau. Hopkins. *Elec. Eng.*, Dec. 30.—A brief, illustrated description of the instrument used in Washington for recording the tremblings of the earth; it consists of a weight suspended on a wire so that the tremblings of the earth making electrical contacts are recorded on a chronograph together with a time record.

Hefner Standard Lamp.—Prog. Age, Jan. 1.—The beginning of an article of some length, giving a detailed illustrated description of this lamp, with working drawings and dimensions.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telegraphy Without Wires. Preece. Lond. *Elec. Eng.*, Dec. 18; an abstract of a recent lecture.—He gives the details of various experiments, intentional and unintentional, and then refers to the Marconi experiments which, as will be remembered, have been conducted secretly under the direction of Preece; this system depends not on the electromagnetic but on the electrostatic effects; Hertzian waves of 250,000,000 vibrations per second are used; such small waves can be projected in one direction only, like light, and their power is therefore not so enormously diminished in transmission to any distance. He then made the first public exhibition of this apparatus, showing it, however, only in the form of sealed boxes one at each end of the room; a signal was made in one of them and a bell immediately rung in the other; no further description is given in the abstract and therefore probably not in the lecture. The British Post Office is sparing no expense in experimenting with the apparatus and one of the first trials will be from Penarth to an island in the channel. He has the greatest faith in the apparatus; no new principles are introduced, but Marconi has invented devices which are said to be highly novel and very beautiful, and when they are patented and made public Preece thinks they will be admired by every one; communication by this method is of course not affected by either fog or rain.

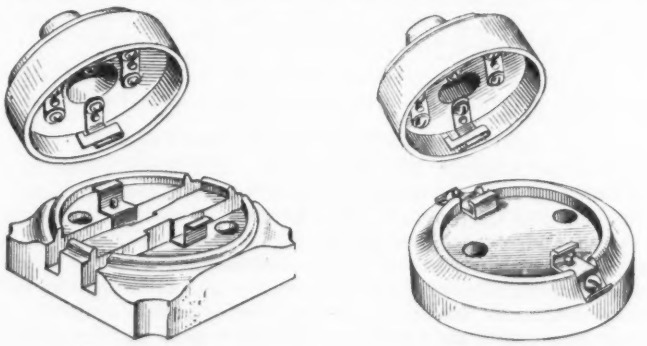
Mutual Action of Telephone Lines. Wilke. *L'Eclairage Elec.*, Dec. 19.—An abstract of a pamphlet describing the Mueller system in which the principal cause of the effects of telephone lines on each other is thought to be due to faults in the insulation; in this system he endeavors to have a certain symmetry in the lines on one pole in order to prevent one line from influencing another. (The system has been referred to before in these columns, the articles being mostly unfavorable criticisms.)

International Telegraph Conference.—Lond. *Elec. Rev.*, Dec. 18.—A continuation of the discussion of the subject.

The B. E. Rosette.

The B. E. rosette, recently placed on the market by the Bryant Electric Company, Bridgeport, Conn., possesses some features worthy of the consideration of the trade. The manufacturers call special attention to the following points:

All caps are interchangeable; increased space near fuse terminals for quick wiring; shoulder on contacts prevents cap from "creeping" off through vibration of building; contact springs are adjustable.



Square Base. Round Base.

The last point the Bryant Company claims is a strong one: Should the contact ever become worn by use, or should it be discovered during the work of installation that the cap does not fit perfectly, a slight bending of the yielding arms in the cap will adjust it instantly to any tension required. This last feature is one that will undoubtedly commend itself to the trade generally.

The illustrations show it in two forms, the square base for moulding work and the round base for cleat work, but it is also made in round base for concealed wiring.

New Electric Railway Line in Pittsburg.

The Birmingham Traction Company has opened a new line from the suburbs of Pittsburg.

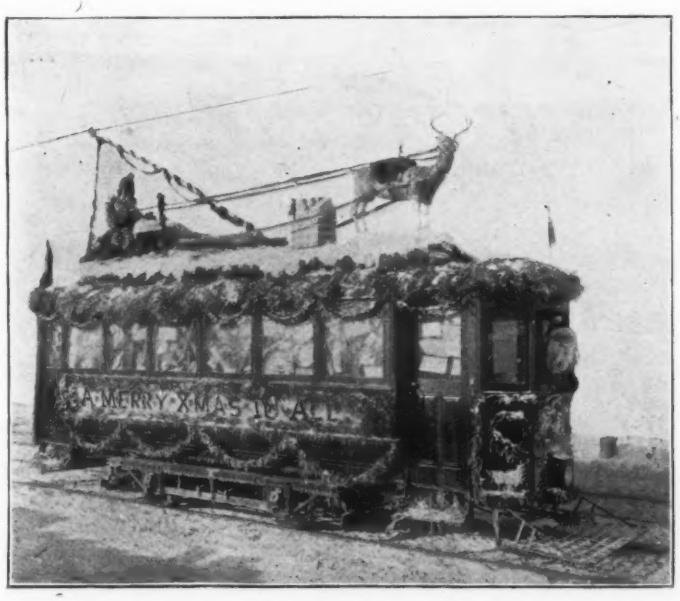
The Hilltop line is a branch of the Pittsburg & Birmingham Traction Company, which connects the old City of Pittsburg with those districts situated on the southern shore of the Monongahela River. It runs across the Monongahela over the Smithfield Street bridge and goes up Brownsville Avenue, which road has a grade of 15 per cent. By this road the suburb of Knoxville is reached. The line has been a great necessity,

because it will afford rapid transit facilities to about 50,000 people who have hitherto been entirely dependent upon inclines and such walking accommodations as unpaved streets afforded.

The Birmingham Traction Company operates 22 cars on the Hilltop line; the cars are equipped with two 50-hp Westinghouse motors and controllers. To take care of the increased traffic occasioned by the opening of this line, the company has recently remodeled and re-equipped its power-house at Thirty-first and Carson Streets. This power-house was equipped with generators of an older make. They have all been thrown out and three 700-kw Westinghouse generators have been substituted.

Santa Claus Visits Ottawa in an Electric Car.

Our ancient friend, Santa Claus, having come to the conclusion that reindeers are not swift enough for city street travel in this rapid age when everything is done by electricity, decided to try an electric car this year, and selected Ottawa, Ont., as the place for the experiment. He interested Mr. Soper, of the firm of Ahearn & Soper, in his scheme, and the result was successful beyond measure. Mr. Soper, however, claims to have originated the idea. For some days previous to Christmas Day Mr. Soper caused letters to appear in the newspapers dated from various points between the North Pole and Ottawa. These letters were signed "Santa Claus," and gave the information that he had decided to make a daylight visit to the city, and that he would arrive with his reindeer the day before Christmas and go through the streets of the city mounted on the top of an electric car. Santa Claus intimated that his visit was made specially in the interest of the children, in order that they might see him in person and that during his trip through the city he would distribute several thousand oranges. He furnished a time table indicating the hours at which he would pass the various street corners. The result of these letters was that for some time before his announced appearance on the afternoon before Christmas the streets were thronged with men, women and children. Promptly on time the car came in sight, covered with snow and ice, and apparently just arrived from the far North. On the front vestibule were the figures "1896," and on the rear vestibule the figures "1897." The interior of the car was filled with toys of every description. Santa Claus himself was on top, seated on a toboggan and driving his reindeer. The basket on Santa Claus' back, as well as the chimney appearing through the top of the car, was overflowing with toys. The motorman and conductor were costumed as Icelanders, and beside the motorman stood an Esquimau who played on a cornet during the trip. As the car proceeded Santa bowed in a genial way to the throngs, and from a basket in front of him distributed oranges. He was aided in the distribution by several assistants inside the car. Some 4000



HOW SANTA CLAUS VISITED OTTAWA.

oranges were thus thrown to the children. The scrambling for them furnished no end of fun.

The whole affair was carried out most successfully, and created greater interest and excitement than any event that ever transpired in Ottawa.

New Röntgen-Ray Apparatus.

Mr. E. V. Baillard, 106-108 Liberty Street, New York, has succeeded in producing an induction coil that is a marked improvement over many of its competitors, and is worthy of notice. He has so thoroughly strengthened the insulation of his coils that there is no fear of breaking down the insulation between primary and secondary, and sparks allowed to pass from the one coil to the other will be only the thin attenuated ones due to induction, and cannot do any harm. In many coils the spark so obtained is thick and brilliant, which is evidence of an actual circuit between the two coils. The complete insulation of Mr. Baillard's coils is further evidenced by the fact that but one pound of wire suffices for two inches in length of spark, a result which most makers have yet to approach. This

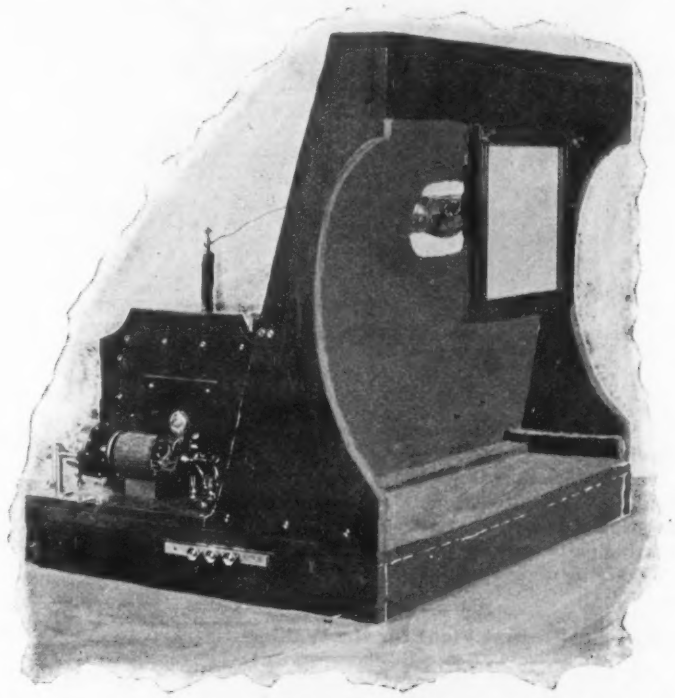


FIG. 1.—EXHIBITION OUTFIT.

makes the spark very thick and fat, or, to be more scientifically correct, highly calorific, and especially suited for the production of Röntgen rays. Coils have been produced according to these designs that will spark directly across their secondary terminals which are placed at the opposite ends of the coil. The distance struck is thus very nearly the actual length of the coil itself.

Two outfits are offered for sale, namely: An exhibition outfit, a view of which is shown in Fig. 1, and a medical outfit shown in Fig. 2. The point of difference between the two is that the exhibition outfit uses a fluorescent screen and hood, which with a curtain covers

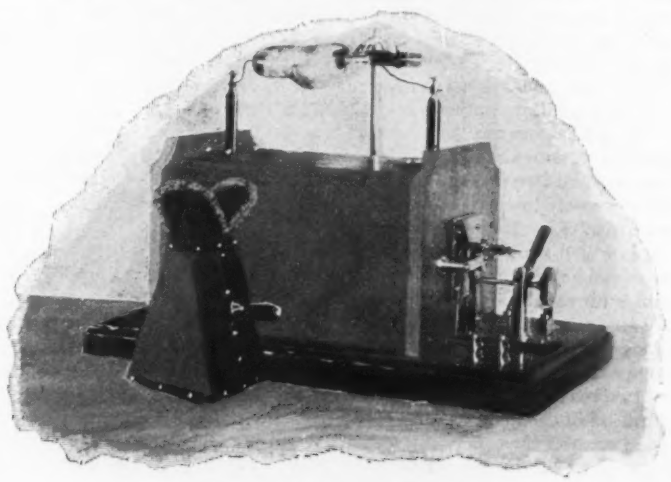


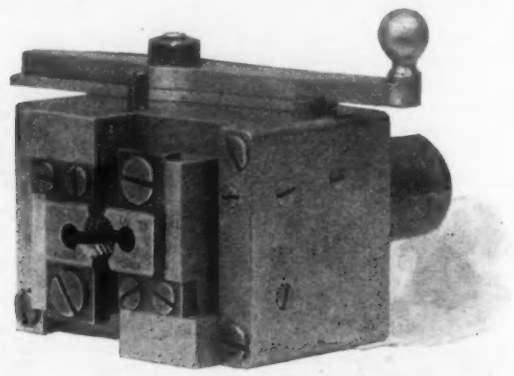
FIG. 2.—MEDICAL OUTFIT.

the whole observer, while the other outfit uses a fluoroscope which is more convenient in observing general objects. Either of these coils will be provided with a rotary circuit-breaker and a variable condenser if so ordered.

The tubes used in these outfits are of remarkable penetration, and examinations of the human trunk can be conducted with ease by their aid. The ordinary vibrator has undergone substantial improvements at the hands of Mr. Baillard, and by means of this improved device the length of the spark a coil can produce is largely increased. The modification consists of a mechanism by which the circuit is kept closed for a long period of time and opened almost instantaneously. This enables the full current to be broken, a result that is always desirable to attain.

Die Head.

Charles H. Besly & Co., 10 and 12 North Canal Street, Chicago, call the attention of the trade to the Gardner No. 94 die head, which is illustrated herewith. This die head is built to approximate a solid die as closely as possible. This result is obtained by using few moving parts and having those parts very stiff. The sliding die-carriers extend across



Die Head.

the full length of the head, giving long wearing surfaces and much rigidity.

The dies are closed by a taper pin forced into the back of the die-carriers. The following points of advantage are claimed for the Gardner die head: As stiff and rigid as a solid die; will cut threads true to size; wearing parts are few; will not wear out quickly; will not clog with chips; will do as fine and close work as desired, and cost of extra dies small.

Large and Elegant Plant for the Waldorf Hotel, New York City.

The new Waldorf Hotel, which occupies the block between Thirty-third and Thirty-fourth Streets on Fifth Avenue, New York City, is to have one of the most extensive electric plants in this country, and the Walker Company, Cleveland, O., has secured the order for the electrical apparatus.

In many respects this plant is unique and interesting, and possesses the distinguishing feature of being the largest isolated plant in the world, having a capacity of 25,000 lights, which are to be used only for lighting this building.

The engine room is to be one of the most elaborate and handsomely fitted rooms ever designed for the reception of any kind of machinery. It is to be somewhat on the plan of the marble engine room at Keith's Theatre, Boston, but will be much more elaborate and extensive, the walls, wainscoating and ceiling being of onyx, and tastefully decorated. The floor is to be of marble of pleasing design. Around the upper portion of the room is to be a balcony which completely surrounds the place and from which guests and visitors to the hotel may view the machinery below. In this way the engine room will be made one of the attractions of the hotel, and will certainly prove as interesting an entertainment to a large class of its patrons as the courtyard or finest parlors.

The generators are to be of the Walker type, manufactured in Cleveland, O. There are to be six generators in all, four of them of 250-kw capacity and two of 100-kw capacity. The first-named generators are of the extremely low speed of 90 revolutions per minute, and the other two run at 100 revolutions per minute.

It is a well-known principle that no translating device whatever, if it be driven at a high speed, is capable of delivering very much more power than if its revolutions are slower. If these machines were wound to deliver their output when run at a speed which would be considered the maximum safe working speed, they would be capable of supplying 50,000 lights, enough for a good-sized city. This slow speed was desirable for two reasons: First, because the slow speed very much reduces the vibration of the machine and increases its life; and second, because this speed enables the direct-connection of the dynamo to a Corliss engine. High-speed engines are invariably used on all direct-connected isolated plants, and we have yet to learn of one which is like the proposed Waldorf Hotel in this respect. The engines are to be of the Allis-Corliss type, direct-connected to the Walker generators.

A slow speed plant always has a more dignified appearance than one of a smaller unit running at a high speed, however quietly, and therefore this arrangement of slow speed machinery is especially suited to the nature of the Waldorf Hotel, which will, without doubt, be the finest institution of its kind in the country.

A description of a dynamo machine is usually of quite a perfunctory nature, but in this case, the machine being of a decidedly unique character, the details may be of more interest.

The machines are to be multipolar, the field frame being of cast iron, while the pole-pieces are of laminated wrought iron and are supplemented with a steel pole shoe, this being a special feature of the Walker machinery.

The armatures are to be of the Walker regular straight-toothed formed coil type and are to be provided with the regular end flange, which forms a substantial cast iron pocket to support and protect the ends of the coils. The windings to be of the barrel type, and by this means almost all of the wire comes under the influence of the pole-pieces and is active.

The machines are to be especially well finished. All brass parts are to be buffed, polished and lacquered, and the bodies of the machines are to be filled smoothly, enameled and elaborately decorated.

The Walker machines have always been particularly noted for the practically negligible movement of the brushes from no load to an enormous overload in order to provide sparkless running, but in these machines the armature reaction will be so light that absolutely no attention of this kind will be required.

Mr. John Jacob Astor, the owner, is known for his knowledge and interest in electrical matters, and has determined to have the finest plant of its kind installed in his hotel, and toward this end has secured the services of the eminent electrical expert and engineer, Mr. C. O. Mailloux, of New York City.

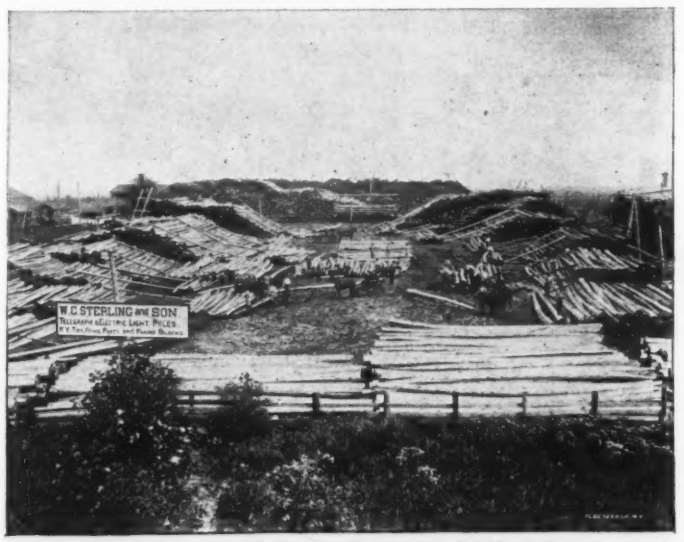
Among those interested in the Walker Company are ex-Gov. Flower, J. W. Hinkley, Perry Belmont and Anthony N. Brady, of New York; Dallas Sanders, of Philadelphia; S. E. Williamson and Jacob B. Perkins, of Cleveland, and several Boston capitalists.

Cedar Poles for Electrical Uses.

One of the oldest and largest cedar-pole firms in the United States is that of W. C. Sterling & Son, Monroe, Mich. In 1880 W. C. Sterling, Sr., entered the business, which has so increased that the firm now has eight large cedar-pole yards in Michigan.

We illustrate the method of receiving the poles on their arrival at one of the firm's sorting yards. Each pole is inspected, carefully peeled, trimmed of knots and all crooks cut out, leaving it ready for shipment. After the pole is properly inspected and trimmed it is hauled to the pile to which it belongs, according to its length and size. This assorting of poles enables the filling of orders at once, without delay of any sort, and the firm has established a reputation both for prompt shipment and the high grade of its poles.

During the last year W. C. Sterling & Son handled more than 150,000 cedar poles, employing a force of eight foremen, 10 office men, 150 woodsmen and 50 yardmen. During the year the firm shipped poles to Buenos Ayres, S. A., as well as to Texas, Salt Lake City and Colorado. Their poles are also extensively used in Canada. The business is so well arranged and managed that the firm is enabled to sell its poles cheaper than in the past. For city use considerable skill is necessary in the manufacture of poles. Such a pole must be reasonably straight and well



View of Pole Yard.

proportioned, and this firm, with its experience, is able to meet every demand in this line. Poles range from 25 to 75 feet in length, those of the 25 to 30 foot sizes ranging in top diameter from five to seven inches, and those of the 35-foot lengths, six and seven inches.

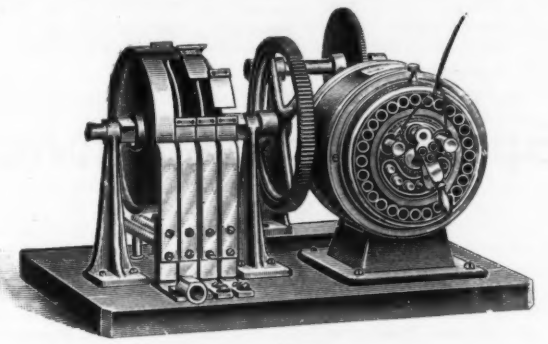
At the headquarters of this firm at Monroe is located what is claimed to be the largest pole yard in the world, but in order to save expense of handling and to meet competition, yards in the northern part of the State have been established. The poles are taken directly from the cedar swamps to the firm's yards either by wagon or driven down the river. Some poles are floated over 100 miles, and at one time last season there was a jam of cedar poles five miles long.

Under ordinary circumstances cedar poles last for many years, de-

pending on the soil in which they are placed. An enormous number of trees are cut annually to supply poles for repairs and extensions of existing electric lines operated by street railway, telephone and telegraph and electric light companies, besides new undertakings of like character. In addition to the manufacture of cedar poles this firm supplies cross-arms, oak pins, and octagonal pine poles, all of which are made to standard specifications.

Automatic Illumination Cylinder.

The device illustrated herewith was designed by the Emerson Electric Manufacturing Company, St. Louis, Mo., for use in operating electric signs, illuminations and decorations. The apparatus shown is a three-circuit cylinder operated by an Emerson alternating-current motor. The revolutions of the motor armature are communicated to the cylinder by



ILLUMINATION CYLINDER.

means of gearing. The cylinder, it will be noticed, consists of a series of segments which pass under spring fingers, thus making contact and closing the circuits.

The apparatus is intended to give moving and color effects in stationary lighting and may be made with any number of circuits or combination of effects. The lights on each circuit, of course, are lighted and extinguished at regular intervals, and the applications of this device in this particular field are practically unlimited.

This apparatus has lately attracted a great deal of attention and the Emerson Company has received a large number of orders for the same.

Electric Switching Locomotive.

The use of the electric locomotive for switching purposes in steam freight railway yards is likely to receive a marked impetus by the fact that one is now employed in connection with the New York, New Haven & Hartford Railroad, at New Haven, Conn. This locomotive is in constant service switching freight cars between the main line of that road and a number of factories located along the river front. The line over which it operates is about two miles long and is the property of several large manufacturers.

The practice followed by the manufacturers hitherto in switching their cars has been for the freight engines of the N. Y., N. H. & H. R. R. to drop the cars at the junction; from here they were hauled to the different factories by horses. This method was so slow with the several curves and grades and so hard upon the horses that the manufacturers were driven to the conclusion that some other method of traction must be employed.

Electric traction was finally adopted as presenting many economical and other advantages, and an order was placed with the General Electric Company for a 30-ton locomotive, which the company could guarantee would haul two loaded freight cars up a 2½ per cent. grade at a speed of seven miles an hour.

The locomotive was delivered at New Haven on the 8th of December, and on the 11th was put into actual operation without preliminary test on the line. Since that date it has been handling the entire movement of the cars between the factories and the junction.

The dimensions of the locomotive are as follows:

Weight	58,000 pounds.
Draw-bar pull	7,000 pounds.
Length over draw-bars	16 feet 6 inches.
Height over all	11 feet 6 inches.
Width over all	8 feet 3 inches.
Wheel base	5 feet 6 inches.
Diameter of drivers	44 inches.
Number of drivers (with cast iron centres and steel tires	4
Size of journals	5½ inches.
Gauge	4 feet 8½ inches.
Voltage	500
Amperes, full speed and normal draw-bar pull	600
Amperes, half speed and normal draw-bar pull	300

The motors are two in number, each axle being provided with its own motor. The motors are gearless and are supported upon a system of spiral springs resting on the side frames of the locomotive truck. The suspension being entirely upon springs the wheels are free to adjust themselves to the irregularities of the road-bed, and the wear on both tracks and motors is thus consequently diminished.

In the armatures the ironclad type of construction has been followed. The armature and commutator are upon a sleeve, through which the axles pass. The sleeve rests in bearings on the motor frame. Two projecting arms from the sleeve fit into the openings in an iron plate loose upon the axle, and similar projections from the wheel enter the plate from the other side, so that, as the armature revolves, the wheels are revolved also. This coupling, being flexible, allows perfect freedom of motion. The commutators are of substantial construction, and each motor has four sets of brushes.

The interior of the cab is finished in cherry and contains the rest of the electrical equipment—automatic circuit-breaker, controller, lightning arrester, reversing switch, air pump, air gauge, etc.

The controller is the L2 series-parallel type, arranged for the control of two motors. It is of the same general type as the K2 used in ordinary street car practice and is provided with separate reversing switch and the magnetic blow-out. The resistances are set beneath the shields and are of the packed ribbon type.

The automatic circuit-breaker is of 500 amperes capacity and involves also the magnetic blow-out principle, as does the lightning arrester,

ELECTRIC SWITCHING LOCOMOTIVE.

which is set upon the floor of the cab behind the controller. In the front of the cab and above the controller is a circular dial ampere meter reading to 500 amperes and facing the motorman in the air pressure gauge. On the other side of the cab, opposite the controller, is an oscillating cylinder air pump, driven by a motor. This furnishes air to two air tanks suspended beneath the cab, and is automatic in its action.

Electricity for this locomotive is furnished from the Fairhaven and Westville power house, which stands on Grand Avenue, about the middle of the line, and the current is taken by trolley from an overhead wire suspended from brackets. The operation of the locomotive is marked by extreme smoothness, and without load it can be run at almost any speed, and with load starts without jerk of any kind.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Jan. 6, 1897.

ELECTRICAL STOCKS.—There was more strength to the market in this class of securities since our last report, prices, with one exception, advancing quite materially. The single exception was Westinghouse Common, which receded 1 point. The principal active stocks with gains to their credit may be named as follows: Edison Electric Ill., of New York, 2½; General Electric preferred, 5, do. common, 1¾. Electric Storage Battery shows an advance of 1 point on the Philadelphia market.

TELEGRAPH AND TELEPHONE.—There seems to be a stronger feeling in these securities. The principal gains were Commercial Cable, 10 points; Western Union and Erie Telephone, fractional; Bell Telephone and New England Telephone were on the negative side, the former dropping 2½ points from the last quotations and the latter 1.

TRACTIONS.—The street railway list was without any special activity or feature during the past week, and while there were both losses and gains, the changes in any one instance is not particularly marked. Baltimore Traction dropped off 2 points, and Columbus Street Railway is 1 point cheaper than it was last week. The gains, what few there were, are merely fractional, the other stocks in the list remaining practically unchanged.

DIVIDEND.—The Edison Electric Illuminating Company of New York has declared a quarterly dividend of 1½ per cent., payable on Feb. 1.

THE BELL COMPANY'S CAPITAL.—It is reported that the directors of the American Bell Telephone Company will ask the stockholders at the annual meeting on March 30 next for authority to increase the capital stock of the company during the year.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Chicago Edison Company	100	..	..
Edison Electric Ill., New York	100	102½	104
" " " Brooklyn	100	88	93
" " " Boston	100	..	..
" " " Philadelphia	100	..	..
Edison Ore Milling	100	7½	10
Electric Storage Co., Philadelphia	100	28	28¼
Electric Storage, pref	100	30	50¼
General Electric	100	33⅜	33¾
General Electric, pref	100	75	77
Westinghouse Consolidated, com	50	24	25
" " pref	50	50½	52

BONDS.

Edison Electric Ill., New York	105	105	..
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	90½	—

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	207	208
American District Telegraph	100	*29	39
American Telegraph & Cable	100	85	..
Central & South American Telegraph	100	124	127
Commercial Cables	100	160	172
Erie Telephone	100	64¾	65¼
New England Telephone	100	102	..
Postal Telegraph-Cable	100	91	94
Western Union Telegraph	100	83	84

ELECTRIC TRACTION STOCKS.

Baltimore Traction	25	17¼	17⅜
Brooklyn Rapid Transit		18⅝	19
Brooklyn Traction	100	..	14
" " pref	100	46	48
Buffalo St. Ry	100	74½	76½
Cleveland Electric Ry	100	..	..
Columbus St. Ry	100	40	43
Hestonville	100	51	52
" pref		..	62½
New Orleans Traction	100	10	12
" " pref	100	40	50
North Shore Traction	100	21	24
" " pref	100	72	78
Rochester St. Ry	..	16	19
Steinway Ry	..	45	50
Union Railway (Huckleberry)		98	103
Union Traction, rcts $10 pd	..	12¾	13
West End, Boston	100	65¼	65½
" " pref	100	85	87
Worcester Traction	100	19½	21
" " pref	100	94	96

BONDS.

Brooklyn Rapid Transit 5s. 1945	100	77¾	..
Buffalo St. Ry. 1st con. 5s	100	*106	109
Cleveland Elec. Ry. 1st mtge 5s	100	102	104
*Columbus St. Ry. 1st 5s	100	94	96
Rochester St. Ry. 1st 5s	100	..	98
Union Railway (Huckleberry) 1st mtge 5s		*101	104
*Westchester Electric 1st mtge 5s	100	100	103

* With accrued interest.

STREET RAILWAY EARNINGS.—The North Shore Traction Company's gross earnings for November last were $102,288, an increase of $3739, as compared with the same month in 1895, and net earnings $38,311, an increase of $8458. The New Orleans Traction Company's earnings for November were $104,230, a decrease of $17,170, as compared with the same month of 1895, and net earnings $42,931, a decrease of $15,910.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, Jan. 7, 1897.

MR. I. M. POST has resigned his position with The E. S. Greeley & Co., New York, and next Monday will join the forces of Messrs Stanley & Patterson, 32 Frankfort Street, this city, as salesman in New York and vicinity.

MR. F. S. TERRY, vice-president of the Sunbeam Incandescent Lamp Company, Chicago, has been in New York during the past week and has made arrangements with the Western Electric Company, of this city, to handle the Sunbeam lamp. A complete stock will be carried.

JAHL & ELLIS is the name of a new firm which has established itself at 39 Cortlandt Street, New York, for the purpose of dealing in electrical supplies. Mr. B. H. Ellis, of the firm, was during the past four years cashier for the New York Electric Equipment Company. The other member, Mr. A. C. Jahl, is well known in the trade. The firm commenced business on Jan. 1.

LARGE THREE-PHASE TRANSMISSION PLANT.—In the issue of THE ELECTRICAL WORLD of Dec. 26, 1896, brief reference was made to the proposed new plant of the Edison Electric Illuminating Company, of Brooklyn. The new station will constitute a three-phase transmission plant, the current being used as a wholesale source of supply to the company's four present stations. The current will be developed into high tension for series arc lighting; low tension for Edison work, and two-phase for alternating.

ELECTRIC LIGHT AWARDS.—The Gas Commission has awarded contracts for city lighting for 1897 as follows: Brush Electric Illuminating Company, 771 lights at 40 cents each per night; Mt. Morris Electric Light Company, 519 lights at 40 cents; Harlem Electric Light Company, 66 lights at 40 cents; Manhattan Electric Light Company, 728 lights at 40 cents; Edison Electric Illuminating Company, 208 double lights at 50 cents; Edison Electric Illuminating Company, 233 single lights at 40 cents; North River Electric Light & Power Company, 934 lights at 45 cents. The total cost of electric lighting will be $529,751.50.

MESSRS O. B. GREENE, Deronda Levy & Co., and Green & Dikeman, on Dec. 1 last, combined their respective business interests under the corporate name of "Ward Electric Supply & Construction Company." The new concern will continue the business heretofore conducted as contractor and dealer in "Ward" and "Knight" lamps, and dealer in imported and domestic carbons and supplies. The company's headquarters are 39 and 41 Ann Street. Mr. O. B. Greene will manage the office and Mr. Deronda Levy will have charge of the construction and mechanical departments. The new company assures its old patrons and the trade at large that it is now in a better position than heretofore to render prompt and satisfactory service. Its lamps are standard goods, and the new company has in them a good foundation for its business.

THE LATE MR. LUFKIN.—At the regular meeting of the directors of the Crocker-Wheeler Electric Company, held Dec. 23, the following resolutions were passed.

WHEREAS, In the death of Mr. Harvey Lamb Lufkin, manager of sales of this company, we have sustained a severe loss, and

WHEREAS, Mr. Lufkin has been from a period early in the history of the business an almost constant associate of the founders of the company, and was an authority of wide reputation, whose thorough knowledge of this subject and devotion to the company's interest has contributed largely to its success.

Resolved, That this minute be made as an expression of our appreciation of the man and his work.

THE EFFECT OF TROLLEY COMPETITION IN BROOKLYN.—The annual report of the Brooklyn Elevated Railroad Company, Brooklyn, N. Y., shows a traffic decrease of 7,460,132 passengers as compared with the report of the previous year. President Uhlmann in his report ascribes this to two causes—the hard times of 1896 and the competition of the surface roads. Negotiations are pending, he states, whereby the Kings County and the Brooklyn Elevated Companies would be operated under one management by traffic arrangement or merged on a fair basis. Such an arrangement would result in reduced operating expenses, better service and increased receipts. New capital is necessary, however, to enable the combined companies to change their motive power, so that without increasing operating expenses cars could be operated at more frequent intervals, which of itself would materially increase the earnings.

ANOTHER RAPID TRANSIT PROPOSITION.—At the meeting of the Rapid Transit Commission on Dec. 30, a new route and general plan for a railway through the city, to be constructed by the municipality, was presented. It was announced that the plan was put forth tentatively, to see what the New York public would think of it. The new route begins at South Ferry, runs thence northerly as a two-track line under Broadway and Park Row to Chambers Street. From Chambers Street it proceeds northerly as a four-track road under Elm Street and Fourth Avenue to Forty-second Street, thence westerly under Forty-second Street to Broadway and thence northerly under Broadway and the Boulevard to 104th Street. At 104th Street the road will be divided into two two-track branches, the western branch, going under the Boulevard to Kingsbridge; the easterly branch, starting from 104th Street, will run under private property to Lenox Avenue and 106th Street, thence northerly under Lenox Avenue to the north side of the Harlem River and thence to Bronx Park. It is proposed to cross the Harlem River in a tunnel near the end of the Lenox Avenue branch and by a bridge at Kingsbridge. It is estimated that these lines could be constructed for about $35,000,000.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., Jan. 6, 1897.

CANADIAN NIAGARA POWER TUNNEL.—The important statement is made that the franchise of the Niagara Falls Power Company, for the building of the Canadian power tunnel across the river, has been extended for four years. Chief Engineer Breckenridge said he understood that the extension will be made, if it is not already made.

TESLA'S LECTURE IN BUFFALO.—An effort is being made by the Buffalo Society of Natural Sciences to secure Nikola Tesla for a lecture to be given shortly in this city. Mr. Tesla will be present at the electric banquet on Jan. 12, and it is hoped that he may speak in public while in the city. The invitation extended to him is signed by many distinguished citizens, among them Mayor Jewett, Dr. Roswell Park, Dr. Park Lewis and Mr. E. B. Guthrie.

EXTENSION OF NIAGARA FALLS & SUSPENSION BRIDGE LINE.—The Niagara Falls & Suspension Bridge Street Railway Company expects to start in the Spring to extend its newly acquired Devil's Hole line from its present terminus to the Riverdale Cemetery. The Rome, Watertown & Ogdensburg Railroad Company already has a station at the cemetery, so that funeral trains run into the grounds. Arrangements are about completed which will bring the rate of a funeral train down to $5 per car for funerals from the City of Niagara Falls.

DAMAGE BY THE NIAGARA POWER TUNNEL OUTLET.—The water that is discharged into the lower river from the tunnel of the Niagara Falls Power Co. is undermining one of the abutments that has been constructed for the proposed steel arch bridge, which is to take the place of the carriage suspension bridge. The water is discharged from the tunnel with such force that a large boulder when dropped in near the mouth is swept into the river. The water has been gradually undermining this abutment. To remedy this it was proposed to do some excavating on the down river side of the outlet in order to divert the water more in that direction. A gang of men has commenced this work.

MR. ALFRED H. COWLES, of the Cowles Electric Smelting & Aluminum Company, with which the Pittsburg Reduction Company has been and is at war legally, visited Niagara Falls last week. It is not generally known that Mr. Cowles' company is waging a sharp legal contest with the Carborundum Company, of Niagara Falls. The case was recently argued in the United States Circuit Court for the Western District of Pennsylvania at Pittsburg before Judge Buffington. E. M. Dickerson, of New York, and C M. Varce, of Cleveland, appeared for the Cowles Company while Messrs. Bakwell and Christy, of Pittsburg, who are also the attorneys for the Pittsburg Reduction Company, presented the case for the Carborundum Company. The court gave the attorneys five days in which to make their oral argument and Mr. Dickerson occupied three days in succession. The point at issue is the alleged infringement by the Carborundum Company upon the patents of 1886 of Alfred H. Cowles and the late Eugene H. Cowles, of their process and electric furnace. The Cowles Company seeks an injunction restraining the Carborundum people from making carborundum or until some settlement between the two companies is reached.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, MASS., Jan. 7, 1897.

MR. F. S. TERRY, of Chicago, was a Boston visitor this week, active and alert as always, and presenting withal his usual greeting and happy smile.

THE HANCOCK INSPIRATOR COMPANY, Boston, Mass., announces that it now conducts the sale of its goods direct, and that orders will receive prompt attention.

THE TELEPHONE EMPLOYEES' MUTUAL BENEFIT ASSOCIATION of Boston, announces its sixth annual ball to be held at Copley Hall, Wednesday evening. Jan. 27, and the usual good time may be expected. The association is deserving of all possible support.

MR. J. C. CAMP, New England manager for the Perkins' Electric Switch Manufacturing Company, Hartford, Conn., spent several days in Boston and vicinity this week. Mr. Camp is making hosts of friends for the Perkins Company, all of whom, it goes without saying, are also his personal friends.

THE PHILLIPS INSULATED WIRE COMPANY, Pawtucket, R. I., is enabling its many friends to keep tab on time by presenting them with a copy of a monthly calendar. On the back of the same is given a table of weights and measurements of "O. K." weatherproof wire, which is manufactured by this company and celebrated for its superior quality and perfect insulation.

MR. GEORGE H. EAGER, treasurer of the Crosby Steam Gauge Company, Boston, died Friday evening, Jan. 4, after a brief illness. Mr. Eager was an example of the highest type of manhood, combined with business sagacity and integrity. His death is deeply deplored by a large circle of friends, and particularly by the Crosby Company, which he has served faithfully for over 20 years, almost from its inception.

THE BELKNAP MOTOR COMPANY, Portland, Me., has not made any mistake in appointing Mr. A. B. Field as manager of its Boston office, a fact which it will find out before long. The electrical apparatus of the Belknap Motor Company possesses such merit as to command the best representation for which Mr. Field is well qualified after his long experience with the Thomson-Houston, General Electric and other companies. The office of the company and Mr. Field will be located at 65 Federal Street, Boston.

THE SWETT & LEWIS COMPANY has succeeded G. A. Frei & Co., Boston, manufacturer of Röntgen-ray supplies, and will continue the business for the present at the same address, 17 Bromfield Street. Mr. Frei retires to engage in other branches of the electrical business. Mr. Frank H. Swett, of the company, has been connected with the T. H. and General Electric Companies, and he has also held other important electrical connections; Mr. Lewis is new to the electrical field, but possesses good business qualifications, and Mr. Albert W. Rantoul, who will be connected with them, has had an active electrical experience, all of which ensures success for the new company.

HUNTRESS & EWING is the style of a new firm introduced with the new year. Its business is that of electric railway equipments of all kinds and motors and dynamos, new and second hand. The business address of the firm is 8 Oliver Street, Boston. Both Mr. Huntress and Mr. Ewing are widely and favorably known in the electrical field, and have for quite a time been interested together in the Neal Electric Headlight Company, as officials, and the closer business relations now established will undoubtedly result in greater mutual advantages, while the concentration of their energies should also prove of advantage to the electrical field in the way of better service.

THE PETTINGELL-ANDREWS COMPANY, Boston, is sending to its customers, friends and the electrical trade generally a most beautiful 1897 calendar, the handsome engraving upon which is really an artistic gem. Its conspicuous feature is the goddess of electricity standing in the centre of the globe collecting electricity from the clouds and distributing it around the world, a complete circuit being made between the Eastern and Western hemispheres represented respectively by the palm and pine trees as terminals. An arc lamp is held in the right hand of the goddess, old Ocean is the foreground and a city in the background afford additional beauty. "Okonite," the old standby; "O. K." triple-braid line wire and "Interior Conduit" are given appropriate prominence.

THE BIBBER-WHITE COMPANY, 49 Federal Street, Boston, has succeeded to the business of Bibber, White & Co., and the New England Electric Supply Company. Mr. Charles A. White is the president of the new company and Mr. Charles E. Bibber is treasurer, and the company also possesses an able corps of salesmen. The principal business of the Bibber-White Company will be the manufacture and sale of insulated wires, but the company will also act as the exclusive agency for New England of quite a number of electrical and kindred supplies. Mr. Bibber, Mr. White and the general business staff are too well known to require anything in the way of an introduction. They possess such an intimate knowledge of the electrical business and specialties, and also of the New England field, that a successful business career for the Bibber-White Company is a foregone conclusion.

THE BAUSH & HARRIS MACHINE TOOL COMPANY, Incorporated, succeeding the late firm of C. H. Baush & Sons, Holyoke, Mass, is now located in its new plant at Brightwood (Springfield), Mass., which for capacity, commodiousness and general arrangement is about as fine a plant as can be found anywhere. The company, aside from doing a large machine business among which is the Baush patent radial drills, multiple spindle drills, horizontal boring and milling machines, as well as structural work, also do a large foundry business. The foundry is made a separate department and affords ample and better opportunities than ever to handle its increasing business in this line. The moulding room proper is 210 x 50 feet, and is in charge of an experienced superintendent. The melting capacity is in excess of 50 tons per day. The arrangement in this department is thorough and modern, and the equipment of the best, including traveling crane, power hoist, improved furnaces, etc., which enables it to turn out all classes of foundry work, heavy and light, with great despatch. The pattern house is a detached fire-proof building, 140 x 50, two stories high, which is constantly under the care of an experienced man. The foundry business will be closely followed up and any work with which the company may be favored will be carefully looked after, and patrons may be assured of prompt execution of contracts. The officers of the company are William A. Harris, president; Geo. H. Baush, vice-president, and William H. Baush, treasurer. Mr. Harris, from past business connections, is particularly well and favorably known to the electrical field, and his many friends are congratulating him over the important position he now occupies and wish for him and the Baush & Harris Company the brightest of futures.

WESTERN NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, ILL., Jan. 5, 1897.

MR. WM. P. HARPER has just been appointed manager of the Gibbs Electric Company, Milwaukee, Wis.

MR. MORRIS METCALF, agent in Chicago for the Shawmut Fuse Wire Company, Boston, Mass., has moved his office from 100 Washington Street to Room 1511 Monadnock Block.

THE FRANK B. RAE ENGINEERING COMPANY has been organized in Chicago to do a general engineering business. The incorporators are Frank B. Rae, Frank G. Ewald and Herbert McNulta. The new concern will make a specialty of municipal lighting plants and water-works systems.

THE ADVANCE ELECTRIC COMPANY, Indianapolis, Ind., which has just been organized under the laws of Indiana, originates from the purchase of the stock of electrical goods from MacCurdy & Smith by Harry B. Marsh. Mr. Smith, of the old firm, is president of the new and will manage the latter.

VETOED.—The ordinance which was passed by the Common Council recently, providing for a four-cent fare on the street railways of this city, has been vetoed by Mayor Swift on the ground that the inevitable consequence of such reduction will be poorer service and general dissatisfaction among the employees and in the community. Investors also will be frightened, and enterprise will be thereby checked.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, 2017-2023 Locust Street, St. Louis, Mo., has issued a circular to the trade which is ful of hope and promise, not alone for its own business, but is encouraging to those who receive a copy. This company has every facility for manufacturing electrical apparatus on specifications. It manufactures standard apparatus of acknowledged efficiency and excellent mechanical construction. Its celluloid calendar for the month of January is now being distributed with the company's compliments.

THE GATES IRON WORKS, Chicago, announce that they will engage in the high-speed engine business with the Fischer-Gates single and four-valve self-oiling automatic engines, built according to the design and under the patents of Mr. Fred F. Fischer. Their product in this line will be handled by Messrs. Fischer & Whiteside, whose headquarters are at 700-702 Fischer Building, Chicago. Plans for extensive additions to the already very large plant of the Gates Iron Works are completed, and it is intended to push this branch of their business with the energy, experience and business tact characteristic of this company, and they anticipate a large trade in the near future. The catalogue illustrating and describing the novel features of the Fischer-Gates engine will be ready for distribution in a short time. Orders for these engines are already entered. The reputation of this concern and that of the gentlemen who are associated with it will ensure a high class machine and the most cordial and conservative treatment of their patrons.

St. Louis Notes.

St. Louis, Jan. 4, 1897.

FOR ONE VOTE.—An effort will be made by the backers of the Sutler Conduit bill to pass it over the Mayor's veto. Only one vote is needed in the Council, and there are enough in the House of Delegates.

THE COURTS WILL PROBABLY BE APPEALED TO.—The conference between the City Counselor and legal representative of the wire using companies, develops the fact that there will probably be a resort to the courts before the conduit ordinance can be construed satisfactory to both parties.

STREET CAR CURRENTS CORRODE UNDERGROUND CABLE.—A test was made the other day by the Inspector of Street Lighting of a section of the underground cable being operated by the Postal Telegraph Company in the conduit which the Sutler Company laid along Fourteenth Street, and it was found that the lead covering of the pipe was entirely corroded in some places by the electrolytic action of the earth current from the street car lines.

San Francisco Notes.

San Francisco, Cal., Dec. 26, 1896.

THE PALACE HOTEL, San Francisco, Cal., was enterprising enough to have a 40-foot Christmas tree in the main court wired up for 600 16-cp multicolored lamps. Another tree upstairs was wired for 200 miniature lamps.

THE COMMERCIAL LIGHT & POWER COMPANY had a close call on Christmas Day, when there was a severe fire raging around and above its power station in the basement of 510 Commercial Street, San Francisco. Supt. Watters, by strenuous efforts, protected the plant from serious damage by fire and water. Though the belts were ruined by water, the machines were shut down only an hour. The company will soon move to much larger quarters in the Niatic Building.

THE CENTRAL CALIFORNIA ELECTRIC COMPANY, Sacramento, is now successfully operating its new 30-mile transmission plant which transmits two-phase alternating-current at a voltage of 15,000, the highest in use on the Pacific Coast. The initial voltage is 400, stepping up to 15,000 and down to 1100 at Sacramento. The transformers, having a capacity of 1000 horsepower, are self-cooling, requiring no air blast. Two 400-kw three-phase generators and two 20-hp exciters are used. Westinghouse apparatus is employed. Water is obtained from the South Yuba ditches.

English Notes.

(From Our Own Correspondent.)

London, Dec. 23, 1896.

THE LIVERPOOL OVERHEAD RAILWAY.—On Monday last the southern extension of the Liverpool Overhead Railway was opened to the public. This extension is only three quarters of a mile, but is entirely underground. The total length of the Liverpool line now amounts to seven miles, and it carries some 7,500,000 passengers per annum.

PROSPECTS OF ELECTRIC TRACTION IN GLASGOW.—The prospects of electric traction in Glasgow have, if one may judge by the local papers, become somewhat overclouded. It would seem that some inventive mind has hit upon an entirely new form of motor, which, as it makes use neither of "air, fire or water," to quote the words of a Glasgow paper, would seem to embody the utilization of a new form of energy. Can this new motor by any chance be a varient of the Keeley motor? At any rate, be this mysterious motor what it may, its promoters are making strenuous efforts to induce the Glasgow Corporation to allow them to experiment with it on a large scale.

THE DAVY-FARADAY LABORATORY.—The Davy-Faraday research laboratory, which has been founded by Mr. Ludwig Mond in connection with the Royal Institution, was duly opened yesterday by the Prince of Wales. I may say that Mr. Ludwig Mond has spent a round £100,000 on this laboratory, of which £38,000 has been sunk in the building and its equipment and the remaining £62,000 on an endowment fund for the maintenance of the laboratory. What is now wanted are some substantial research scholarships enabling those desirous of making pure science investigations and who are generally by no means over-endowed with this world's goods, to work year after year if necessary, without troubling themselves about their bread and butter.

LOW TEMPERATURE RESEARCH.—At the Royal Society last week Profs. Fleming and Dewar described their method of determining the dielectric constant of liquid oxygen, for which they have obtained the figure of 1.491. They further state that liquid oxygen obeys Maxwell's law very fairly, that is to say, its dielectric constant multiplied by its magnetic permeability is approximately equal to the square of its index of refraction for waves of infinite length. They also stated some very interesting facts with regard to the high resisting power of liquid oxygen. They were able to charge, by means of a Wimshurst machine, some aluminum plates immersed in liquid oxygen and separated from each other by very small gaps, to such a potential that upon discharging this microscopic condenser a decided spark was perceptible. These indefatigable investigators are now proposing to carry low temperature research into the question of the effect of temperatures, such as — 182 degrees C., upon the dielectric and insulating properties of oils and gums.

THE YEAR 1896 IN ENGLAND.—In electric lighting matters the past year has been more noticeable for extensions of existing stations than for the coming into operation of new ones. On the other hand it has been noticeable for the advent of the 200-volt lamp and for the inauguration, by Mr. Gibbings, of Bradford, of a system of giving lamps free to customers with a view of preventing them from being victimized by the makers of the many cheap and worthless lamps now on the market. Mr. Gibbings' idea seems to have "caught on," as a large number of electric lighting committees are announcing their intention of following suit. The supremacy of the Willans engine, which has for so long been a characteristic feature of English central stations, has during the past year, for the first time, been seriously threatened by the Belliss high speed double-acting engine and latterly by Mr. Raworth's "Universal" engine. In electric traction the progress has been slow if we judge merely by the additional track mileage. It would, however, be a great mistake to look at the matter from this point of view only. The fact is, the ice has at last been broken; capitalist and town councillor have been thoroughly aroused, and money is now forthcoming freely for electric railway ventures. The railway systems of Leeds and Birmingham are now in process of being electrically equipped, and numerous schemes are being projected in various parts of the kingdom, with every likelihood of their being realized before long. The past year has been memorable for the commencing of the long-deferred Central London Railway, a tunnel line seven miles long running across London from east to west. In the telephone world the past year has witnessed the taking over of the trunk-wire system of the country by the Post Office and the announcement by the Postmaster-General that the Government does not propose to take over the rest of the telephone system of the country, at any rate until the present license of the National Telephone Company expires at the end of 1911. The National Telephone Company, which has now the complete monopoly of the urban telephone work of the country, has 91,940 subscribers, or 14 per cent. more than it possessed this time last year, its London subscribers numbering over 14,000. There is no gainsaying the fact that the telephone service has immensely improved. The great work of double-wiring the metropolitan circuits has been completed and attention has been turned to carrying out similar work in the provinces. Manchester already enjoys metallic underground circuits, and Liverpool, Leeds, Dundee, Portsmouth, Brighton and other big towns will shortly have a similar advantage. In the telegraphic world, as usual, there is little to record, the most important event being the Pacific Cable Conference. Patent litigation, once so rife in the English electrical industry, was entirely absent in 1896 The only calls made upon the services of our barristers were made in connection with petitions for the prolongation of three important electrical patents, *viz.*, the Dolbear cable patent, the Hopkinson three-wire patent and the Willans Air-Buffer patent No. 4901, of 1892, all of which petitions were summarily rejected by the Privy Council. It is felt by all on this side of the water that the electric lighting industry in England stands on a very sound basis, and that before many more years are over our heads it will be possible to say the same of the electric traction industry. Nevertheless, in spite of the good work which they turn out, and the size of their output, our leading manufacturing firms are by no means prosperous. The usual explanation given of this phenomenon is that it is due to price-cutting. To onlookers, however, who, as the proverb says, see most of the game, it is more apparent every day that the root of the evil is the over-capitalization of the leading firms which, formed in the days when electrical patents commanded immense sums, have suffered ever since from the large sums paid. Another source of the comparative lack of success of our electrical manufacturing undertakings is probably to be sought for in the fact that so many of our large mechanical engineering enterprises are now adding an electrical department as an annex to their other business, and owing to their unique mechanical experience, the excellence of their shop equipment, and the size of their business (turn-overs), are running purely electrical manufacturing concerns very close in the matter of price and quality.

General News.

New Incorporations.

THE PYLE ELECTRIC HEADLIGHT COMPANY, Indianapolis, Ind., has been formed for the purpose of manufacturing electric headlights for locomotives. The incorporators are Louis Hollweg, George C. Pyle and Frank H. Ewers. Capital stock, $25,000.

THE BREWER LIGHT & POWER COMPANY, Brewer, Me., has been formed to generate electricity for light and mechanical purposes. The incorporators are Frank H. Nickerson, John C. Holbrook, J. N. V. Lane. The capital stock of the company is $100,000.

THE MILWAUKEE LIGHT, HEAT & TRACTION COMPANY has been incorporated at Milwaukee, Wis., with a capital stock of $500,000. The incor-

porators are William H. Cromwell, Charles W. Wetmore and C. A. Spotford, of New York; Henry C. Payne, F. G. Bigelow and others, of Milwaukee.

THE BLUE LAKES WATER COMPANY has been formed at Oakland, Cal., for the purpose of acquiring water rights and furnishing water and electric power. The incorporators are W. Frank Pierce, of Oakland; Cyrus S. Wright, John McF. Doble and Jesse W. Lillienthal, of San Francisco. Capital stock, $10,000.

THE PITTSBURG & MT. WASHINGTON ELECTRIC STREET RAILWAY COMPANY has been incorporated at Pittsburg, Pa., for the purpose of building an electric railway four miles in length. The incorporators are Samuel Garrison of Pittsburg; Charles Cramer, of Wilkinsburg and others. The capital stock is $24,000.

THE UNION CONTRACTING & CONSTRUCTION COMPANY has filed articles of incorporation at Trenton, N. J. The incorporators are James J. Cahill, Edwin E. Marshall and Lawrence Barden. The purpose of the company is to construct electric lighting plants in the United States and Canada. The capital stock is $100,000.

THE WEST CHESTER GAS & ELECTRIC COMPANY has been incorporated to supply gas and electricity for heat, light and power purposes in the towns of Harrison, Rye, Scarsdale, Mamaroneck, Larchmont and New Rochelle. The capital stock of the company is $300,000, and the directors are James M. Pendleton and Albert L. Chester, of Westerly, R. I.; George V. Foster, of New York; Wallace Hackett, of Portsmouth, N. H.; Herbert T. Jennings, of Mt. Vernon; Paul Armatage, of Bay Shore, and Henry D. Donnelly, of Brooklyn.

TELEGRAPH AND TELEPHONE.

PALMYRA, ILL.—Omer Ballard, of Nelsonville, is interesting the citizens of this place in a proposed telephone line between this city and La Belle. The places to be connected with Palmyra will be La Belle, Steffensville, Nelsonville, Benbow and Emerson.

WARREN, O.—The Madison Telephone Company has been granted a franchise covering a territory from the corporate limits of Rock Creek to Footville, from Trumbull Centre to Hartsgrove and from the centre of Hartsgrove to the Geauga County line.

ST. PAUL, MINN.—The Northwestern Telephone Company has purchased the Rogers Building, Fifth and Cedar Streets, for $50,000. The company will make many improvements in the building, so as to better adapt it to the requirements of its constantly increasing business.

MARIETTA, O.—The City Council has granted a franchise for the Independent Telephone exchange in this place, work on which will begun in a few weeks. The ordinance fixes the maximum price for each 'phone at $25, as against $36 now being charged by the Bell Telephone Company.

AKRON, O.—The Citizens Telephone Company recently made application for a franchise, in consideration of which it offers to give the city, free of charge, 25 to 30 telephones, to allow the city the use of its poles for fire alarm wires and police patrol system with an instrument free, and to give to the city 5 per cent. of the gross receipts.

ANGLETON, TEX.—The Angleton Telephone Company is building a line from this place to Velasco, a distance of 15½ miles. When this work is completed the company will build a line from Columbia and Brazoria through Angleton to Aldin, a distance of about 40 miles. George G. Garrett has secured the contract for line material and construction work.

ISHPEMING, MICH.—A local paper is authority for the statement that the Bell Telephone Company has lost practically all of its patronage in this place. This condition of things is brought about by a local company which, it is stated, has four times more subscribers than the Bell Company ever had. The Bell people, it is reported, are offering instruments absolutely free to all business houses and professional men who will agree to keep them in their offices during the coming year It is also stated that the Bell Company has been driven out of Escanaba in the same manner.

ELECTRIC LIGHT AND POWER.

RICHMOND, IND.—The appraisers appointed to fix the value of the Richmond, Light, Heat & Power Company, looking to purchase by the city, fixed the value at $54,000. The owners demand $100,000.

DRESDEN, O.—At a recent meeting of the City Council a resolution was passed that the city build its own electric light plant, at a cost not to exceed $18,000, and a committee was appointed to receive estimates and specifications for the same.

PITTSBURG, PA.—The Allegheny County Light Company's plant is being entirely reconstructed at a large expenditure. Four large dynamos will be added to the present equipment, each of which will furnish power for 20,000 incandescent lights and 5000 arc lights.

LITTLE FALLS, N. Y.—The consolidation of the Little Falls Gas Company, the William Henry White Electric Light Company and the Little Falls Electric Light & Power Company has been ratified, the new company to be known as the Little Falls Electric Company.

HUDSON, MASS.—At the town meeting held Dec. 21, it was voted to appropriate $20,000 for the purchase of the Hudson Electric Light Company's plant, for the purpose of establishing a municipal electric lighting plant. A committee was appointed to investigate and report at the next meeting.

MEDFORD, MASS.—The special committee appointed to consider the advisability of establishing a municipal electric lighting plant, has reported that the interests of the city would be better advanced by the building of such a plant. The question will be submitted to the citizens at the next city election.

WILKES BARRE, PA.—An ordinance has been introduced in the Borough Council of Forty Fort providing for the submission to the voters at the next annual election of the question of increasing the borough debt to the extent of $5000. Six thousand dollars was originally voted for the building of an electric light plant, and the additional $5000 is now asked for its completion.

CHICAGO, ILL.—At a meeting of the Cicero Town Board on Dec. 26, a bid was received for the lighting of Oak Park with arc lights from the Cicero Light, Heat & Power Company. The price asked is $64 for each light, to be left burning until 1 o'clock a. m. and the company offers to light the village all night for $93 a year for each light. The bid was referred to a committee.

BRISTOL, VA.—The Consumers' Electric Company has been organized in this place with the following officers: C. C. Cochran, president; C. L. Sevier, vice-president; Albert Parlett, secretary and treasurer. This company has been granted a franchise by the two Bristols, and is now erecting an electric light and power plant in the city having a capacity sufficient to supply from 15,000 to 20,000 people.

THE ELECTRIC RAILWAY.

GOLDENS BRIDGE, N. Y.—The movement has again been revived to build a trolley line from this place to Danbury, and the Danbury & Goldens Bridge Street Railway Company announces its intention of applying to the next Legislature for a charter.

BANGOR, ME.—The Railway Commissioners have received a petition for approval of articles of association of a new street railway to run from Bangor to Garland. The road is to be run by electric power, and will pass through the towns of Glenburn, Kenduskeag, Levant, Corinth, Exeter, Charleston and Garland.

RALEIGH, N. C.—The car barns and engine house of the Raleigh Electric Street Railway Company were destroyed by fire on the evening of Dec. 31. The property loss included nine cars, five dynamos and four engines of 125 horse-power each, together with all the supplies. The money loss is $50,000, and the insurance is said to be only $12,000.

SOUTHINGTON, CONN.—The Southington & Plantsville Tramway Company will ask the Legislature for an extension of the provisions of its charter, granting the right to construct a line in any of the streets of Southington and to construct a line in Plantsville to connect with the Bristol tramway or the tramway extending from Plainville to New Britain.

BROOKLYN, N. Y.—The Steinway Electric Railway Company, on Dec. 24 presented $25 to each of its motormen and conductors who had served one year or more with the company without an accident having been recorded against him. A proportionate amount was given to those who had been in the employ of the company less than a year without an accident.

CHICAGO, ILL.—Members of a sub-committee representing the Bondholders' Committee of the Alley "L" have asked for bids on a power-house plant in connection with the road, and have also requested figures for electrical currents for operating purposes from several companies. It is estimated that the cost of the plant, which is intended to supplant steam power, will cost $600,000 and the equipment of the road $300,000.

CHESTER, PA.—The Chester County Central Railroad Company, recently incorporated with a capital of $600,000, will begin constructing a single track electric line for freight and passengers between Philadelphia and West Chester as soon as the company can be financed. The Union Traction Company will, it is said, connect with the new road at some point at the city line. In the future the line will be extended to Lancaster through Oxford, Quarryville and York.

BROOKLYN, N. Y.—A. R. Moore, counsel for the Brooklyn Health Department, on Dec. 28 obtained a summons against the officers of the Nassau Electric Railroad Company, charging them with neglect to heat their cars in violation of an ordinance which makes it a misdemeanor to run unheated cars when they become a menace to public health. It is stated that numerous complaints have been received by all the street railway companies in this city relative to the cold condition of their cars.

LEGAL NOTES.

IN FAVOR OF THE VIADUCT MANUFACTURING COMPANY.—We are informed by the Viaduct Manufacturing Company, Baltimore, Md., that the suit brought in the United States Circuit Court of Maryland by A. G. Davis *vs.* Chesapeake & Potomac Telephone Company for infringement of Patent No. 223,968, granted to J. H. C. Watts, has been decided in favor of the plaintiff. The court held that the switchboard-pin used by the Chesapeake & Potomac Telephone Company in its exchanges in Baltimore and Washington is an infringement on the Watts patent.

THE ELECTRIC RAILWAY COMPANY of the United States has applied to the Supreme Court for the voluntary dissolution of the corporation. Judge Truax has appointed John Hone, Jr., referee in the matter, and set down the order to show cause for April 7 next. The company has not done active business for the past two years, owing, it is stated, to the litigation concerning its principal patent resulting adversely to the company in 1894. The company was capitalized for $1,000,000. Among the principal stockholders are Rev. Henry M. Field, Frederick F. Thompson,, Stephen D. Field and Stephen J. Field.

SUIT FOR DAMAGES.—Justice McLaughlin, of the Supreme Court, New York, on Jan. 5 heard argument in the action brought by the Electric Power Company to recover $250,000 damages from New York City for the summary removal of its wires and poles under an order made by Mayor Gilroy in 1880. Mr. Roger Foster, who represented the company, said that his client had $300,000 invested in its business under the power given to use wires under or above ground, and that the vested rights for over ground wires thus secured could not be taken away without compensation to the company. He further alleges that after the wires and poles had been cut down they were sold by the city for about $10,000, the city pocketing the proceeds. The counsel for the city urged that the poles and wires were not removed until subways had been prepared, and that the Legislature had the power to require their removal.

Obituary Notes.

MR. C. E. BALL, general manager of the Ball Electric Light Company, New York, died on Sunday, Jan. 3, from the result of an operation for appendicitis. Mr. Ball had been ill but a short time. He was about 51 years of age at the time of his death.

MR. JAMES H. GOULD, president and general manager of the Gould Manufacturing Company, Seneca Falls, N. Y., died in that place on the morning of Dec. 30, of acute congestion of the kidneys. Mr. Gould was born in 1844, and was therefore 52 years of age.

MR. THOMAS C. ROBBINS, at one time general manager of the Union Passenger Railway, Baltimore, Md., died in Boston on Dec. 31, 1896, at the age of 66 years. While in Baltimore Mr. Robbins, in September, 1885, adopted electric motive power (the Daft system) on the Baltimore, Woodbury & Hampden Railway. This is said to have been the first successful venture in the field of electricity by a practical street railway man, and horse power was entirely superseded by electricity.

GEN. FRANCIS A. WALKER, president of the Massachusetts Institute of Technology, died in Boston on Jan. 5. Gen. Walker retired the evening before in apparent good health, but just before midnight he was stricken with apoplexy and died before the arrival of the physician, who had been hastily summoned. All efforts to restore him to consciousness after the stroke were in vain. Gen. Walker had led an active and varied life. He enlisted in the Civil War, and after the war became a teacher and editorial writer, and served in various public positions of honor and preferment. He afterward became a professor at Yale College, and in 1881 president of the Massachusetts Institute of Technology. He organized the tenth census, and in 1882 was chosen president of the American Statistical Association. In 1886 he was elected president of the American Economical Association. Gen. Walker was author of several works on economics. A widow and five children survive him.

Trade and Industrial Notes.

FRANCHISE.—Eugene Hughes & Co. have been granted franchises for subway, electric light power and telephone purposes by the Common Council.

EXPORT COMMISSION MERCHANTS.—M. D. Weil & Co., 725–727 Broadway, New York, announce that they will make a specialty of exporting electrical appliances of every description.

ST. LOUIS ELECTRIC SUPPLY COMPANY, St. Louis, Mo., is presenting the trade with copies of a handsome calendar for 1897, and there is no reason why any one should lose track of time if he has one of these calendars nearby.

BRUNT & THOMPSON, East Liverpool, O, are presenting, with their compliments, a wall calendar for 1897. This company manufactures vitreous porcelain for electrical purposes, and makes a specialty of tubes, insulators and cleats.

THE NATIONAL CARBON COMPANY, Cleveland, O., has gotten up a calendar for 1897, which has an added feature of value. This consists of a moonlight schedule applicable to each month. The calendar gives a colored view of the company's large works, which is very attractive in itself.

THE FITCHBURG STEAM ENGINE COMPANY.—In the last issue of The Electrical World reference was made to an installation of an 800-hp unit by the Fitchburg Steam Engine Company for the Louisville Electric Corporation. The installation was made in the plant of the Lowell Electric Light Corporation and not the Louisville Electric Corporation, as reported.

THE ELECTRIC APPLIANCE COMPANY, Chicago, looks back on the Christmas season just passed as a particularly satisfactory one, not only that it represents the beginning of the company's sixth business year, but also on account of the very satisfactory way in which the orders came in during the month of December. It reports that business seemed to take quite a jump at that time.

THE CUTTER ELECTRICAL & MANUFACTURING COMPANY, 1112 Sansom Street, Philadelphia, has issued a calendar for 1897 which gives a very handsome cross-sectional view of its well-known I-T-E automatic magnetic circuit-breaker. The different parts of this illustration are colored to represent the material of which they are made in practice, and the design is such as to illustrate very clearly the mechanical and electrical action of this important device.

THE ANCHOR ELECTRIC COMPANY, Boston, has just issued the fifth edition of its catalogues, in which is presented most neatly its important electrical manufactures in the line of switches of all kinds, sockets, fusible plugs, cut-outs, incandescent lamp adjusters, gongs and watchman's electric registers. The year just closed has been successful for the Anchor Company, and the tireless energy of its managers augurs still greater success for the year just entered.

A CORRECTION.—The Viaduct Manufacturing Company, of Baltimore, asks us to say that the prices on certain telephone specialties, advertised under the heading of "Special Notice" in that company's card in the New Year's issue, were inserted inadvertently from an old advertisement, and were erroneously stated. The company does not now sell rubber receivers at 70 cents, watch-case receivers at 45 cents, or 250-ohm induction coils at 25 cents, and the 6000-ohm bells have been withdrawn from the market.

THE HEINE SAFETY BOILER COMPANY, St. Louis, is now delivering four 300-hp boilers for another immense United States dredge boat, the *Delta*, which will go into service next season on the lower Mississippi River. The *Beta*, the largest steam dredge in the world, on which the Heine boilers made a very notable record last year, is now laid up for the Winter after a very active season. It will interest boiler users generally to know that although the water used was taken directly from the river and, owing to the dredging operations, was even more than usually muddy, the boilers are reported in fine internal condition at the end of the season.

"PIONEER" LAMP.—The Electric Arc Light Company, 687–689 Broadway, New York, has proved during the present season that economy in light is short-sighted and that goods exhibited and shown in a clear light are much more likely to obtain approval of the buyer than articles shown in a dimly-lighted salesroom. The demonstration of this fact has kept the company busy filling orders for its well-known "Pioneer" enclosed arc lamp. The company informs us that it has been awarded the entire lamp order for the big shoe store of A. J. Cammeyer, at the corner of Sixth Avenue and Twentieth Street. The "Pioneer" enclosed arc lamp was selected for this establishment after a care competitive test, so we are informed.

AMERICAN ENGINES.—The American Engine Company, Bound Brook, N. J., reports the following shipments during December, 1896: One 60-hp American Ball engine, to the *Scranton Truth;* one 50-hp and one 12-hp motor, to the Western Newspaper Union; one 100-light dynamo, to the *Chattanooga Daily News;* one 60-hp American Ball engine, to the *Albany Journal;* one 5-hp motor, to the *Gazette* Publishing Company; one 12-hp motor, to the *Toledo Blade;* one 12-hp motor, to the W. D. Boyce Company; one 9-kw dynamo, to the *Age-Herald* Publishing Company; one 9-kw dynamo, to the *Dayton Journal;* one 3-hp motor, to the *Indianapolis Sun;* one 75-kw dynamo, to the *Inquirer* Company; one 3-hp motor, to the *Harrisburg Telegram;* one 9-kw dynamo, to the Jarecki Manufacturing Company; one 100-hp motor, to the *Boston Herald.*

BALL ENGINES.—The vertical engines being built by the Ball Engine Company, Erie, Pa., for electrical service have been received with the greatest amount of favor by those who appreciate merit and good workmanship in an engine. Since Oct. 1 last, these works, we are informed, have been running till 10 o'clock every night and part of the time all night on account of several large contracts received for vertical engines. Some of these orders are just being completed, among them being a 400-hp vertical cross-compound engine, arranged for direct connection to a 225-kw Siemens-Halske generator, which was shipped a few days ago to the Nicopal Mariopol Mining & Metallurgical Company, Mariopol, Russia, and which will furnish electric power to various machinery in the steel works mentioned. The company will ship in a few days to the Chicago Public Library four 200-hp vertical cross-compound and one 100-hp vertical tandem compound engine, each being direct-connected to two General Electric Company machines. The form of arrangement and details of these engines are entirely new, and the plant when erected will be a very complete one. Besides the above there are building in the works at present one 400-hp vertical cross-compound engine and one 150-hp vertical cross-compound engine for the Shoenberger Steel Company, Pittsburg, Pa., each of which is direct-connected to Siemens-Halske generators. Also for the Apollo Iron & Steel Company, Apollo, Pa., one 150-hp vertical cross-compound engine, direct-connected to a General Electric alternating lighting machine, both the dynamo and exciter being driven from the shaft of the engine and arranged on the same base with the engine.

Business Notices.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 67–71 Park Place, New York City.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, 105 South Warren Street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED DEC. 29, 1896.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

573,859. AUTOMATIC TELEPHONE EXCHANGE SYSTEM; R. Callender, Brantford, Canada. App. filed March 19, 1896. An automatic exchange system comprising subscribers' lines and individual switches at which they terminate, normally under the subscriber's control, and means for giving an independent progressive motion to a switch on the reception of a preliminary impulse from the subscriber normally controlling it.

573,874. DRUM FOR ELECTRIC CONTROLLERS; S. Harris, Johnstown, Pa. App. filed Oct. 6, 1896. In a drum for electric controllers, the use of pins extending upwardly and downwardly from the contact rings of the drum, and recesses on the top and on the bottom of the insulating discs of said drum, said recesses being adapted to receive said pins.

573,884. AUTOMATIC TELEPHONE EXCHANGE; A. E. Keith, Chicago, Ill. App. filed Sept. 16, 1893. An automatic telephone exchange, comprising the combination of release mechanism at the central station operated by a current of electricity which is controlled by a means which is initially started in operation by the gravity of the telephone receiver, said means comprising two compartments with communicating passages between them, and both entering one of said compartments, said wires placed in electrical communication with each other and connecting the battery with the release magnet through the action of mercury or some other electric conductor.

573,903. FIRE ALARM; J. A. McGahy, New York, N. Y. App. filed April 30, 1896. The combination with an electric circuit, means for closing the same

from an elevation of temperature, and a battery for supplying the current of an electromagnet, the armature having a counter weight and a notch or shoulder, a bar having a tag and slot, a contact piece, a wire connecting said contact piece with one pole of the battery, a bell or audible signaling device and two wires connected one from the bar and the other from the battery and both to the audible signal.

573,911. ELECTRIC ARC LAMP; L. H. Page, Chicago, Ill. App. filed March 11, 1896. In an electric arc lamp, a globe having an air-tight closed lower end and carrying within such end a support for the lower carbon, said globe being annularly enlarged at its upper end to form an interior shoulder, a mica disc removably arranged within said upper end of the globe on said shoulder, and means for tightly binding the edges of the disc on said shoulder.

573,924. FIRE ALARM SYSTEM; A. C. Rogers, Plainfield, N. J. App. filed Jan. 25, 1896. In a fire alarm system, a normally closed main-line circuit, including therein in series the fire-boxes, a station gong and a general gong or whistle, a normally open annunciator circuit, including the main-line and an annunciator having a wire connection with each box and with the main line, and a circuit breaker arranged in each box and adapted to alternately break the main line circuit and close the annunciator circuit.

573,929. INCANDESCENT LAMP FITTING; A. Swan, New York, N. Y. App. filed March 28, 1896. The combination with the neck of an incandescent lamp, provided with a bead of glass at or near the end thereof, of a metallic collar placed thereon entirely behind said bead of glass. said collar forming one of the lamp terminals.

573,932. ELECTRO-PNEUMATIC BLOCK SIGNAL SYSTEM; A. H. Thorp, Toledo, O. App, filed April 10, 1896. In an electro-pneumatic block signal system, a weighted semaphore arm normally indicating a clear signal, a catch normally engaging with devices to hold the semaphore arm in a position to indicate a clear signal, a normally closed track circuit, a catch releasing circuit and a setting circuit controlling pneumatic means for returning the semaphore arm to a point to indicate "safety," circuit breakers upon the releasing circuit and upon the setting circuit controlled by the movement of the semaphore arm, whereby when the track circuit is opened by the passage of a train into the block the releasing circuit is closed and the catch retracted and the semaphore arm allowed to rise by gravitation to a point to indicate a danger signal, the releasing circuit being opened by the circuit breaker thereon, when the semaphore arm has completed its movement which releases the catch, to normally be in position to hold the semaphore when it is returned pneumatically under the action of the setting circuit when the track circuit is closed, due to a train leaving the block.

573,944. FIRE ALARM; A. H. West, Lynchburg, Va. App. filed March 30, 1896. In an automatic fire alarm, the combination of a drop lever having one of its ends bifurcated, a hinge plate provided with a stud pivoted to the bifurcated end of the drop lever, an arm secured to said drop lever, a circuit closer disposed below the hinge plate and adapted to be operated by the drop lever, and a combustible cord or other fusible connection secured to said drop lever and provided with branches, a series of eyes for receiving the fusible connection, and a fusible ball mounted on one of said eyes, whereby the drop lever is normally held out of contact with the circuit closer.

573,948. CIRCUIT-CLOSER FOR ELECTRICAL ALARM CIRCUITS; J. C. Wollin, Williamsport, Pa. App. filed Sept. 11, 1896. A circuit-closer for electrical alarm-circuits, comprising a fixedly positioned oscillatory support included in an electrical alarm-circuit, an oscillatory contact-rod adjustably fitted to said oscillatory support. a balance weight adjustably mounted on the rod at one side of its support, a shallow concavo-convex metallic impact-cup fitted to one end of the contact-rod and adapted to be arranged over the point of escape for compressed air, steam or other gas, and a fixedly positioned contact-post included in the same circuit with the oscillatory support and arranged in the path of the contact-rod.

573,962. SEARCH LIGHT; A. E. Colgate, New York, N. Y. App. filed Dec. 24, 1895. In an arc lamp, the combination with the carbons, one of which is held stationary when the arc is formed, and the other being movable, of a feed-screw for said movable carbon, a cluch for said feed-screw, a shunt-magnet for operating said feed-screw through said clutch, a circuit controller in the shunt-circuit operated by the armature of said shunt-magnet to open the circuit, and means for operating said controller to close the circuit independently of the movement of the armature.

573,966. INSULATOR HANGER; R. Duncan, San Francisco, Cal. App. filed Dec. 31, 1895. In combination with an electric wire, of a hanger for electric insulators, consisting of a flat piece of metal bent or cast to removably and loosely fit over the flange of a metal beam, said hanger being retained on said beam by the horizontal tension of said wire.

573,979. APPARATUS FOR VARYING SPEED OF ELECTRO-MOTORS; L. Imhoff, Berlin, Germany. App. filed July 3, 1896. The combination with an electric motor having a plurality of separate armature-windings; preferably wound on one core, separate commutators connected to the respective armature windings, a switch for placing one or more of the armature windings in circuit with the source of electricity and resistances for insertion in series with the motor at every transition from an armature-winding containing a lower number of turns to an armature-winding containing a higher number of turns.

573,992. KEYBOARD APPARATUS; F. R. McBerty, Downer's Grove, Ill. App. filed Oct. 28, 1895. The combination with a plug of a telephone circuit associated therewith, a generator of signaling currents, a key constructed to interrupt said telephone circuit and to connect said generator with the plug, and an instrument through which the severed portion of the telephone circuit is closed by said key.

574,005. TELEPHONE CIRCUIT; C. E. Scribner, Chicago, Ill. App. filed April 30, 1895. The combination in a telephone circuit in a closed circuit with the primary helix and a supply-circuit connected with the central point of said primary helix, the secondary helix of the induction coil being included in circuit with a receiving telephone, whereby variations of current in the supply circuit are prevented from producing undulations of current in the secondary helix.

574,006. TEST SYSTEM FOR MULTIPLE SWITCHBOARDS; C. E. Scribner, Chicago, Ill. App. filed July 5, 1895. In a multiple switchboard, spring jacks connected in multiple with the line, a test contact in each jack, all the test contacts being electrically connected together, means for making connection with the line and simultaneously altering the electrical condition of the test-contacts thereof, a testing plug adapted to be applied to the test-contacts and a telephone in circuit therewith adapted to indicate the said electrical condition, a connecting plug and a visible signal in circuit, with the plug adapted to indicate said altering condition.

574,025. DENTAL PLUGGER OR MALLET; H. A. Edgecomb, Mechanic Falls, Maine. App. filed Sept. 25, 1895. In an electromagnetic dental plugger, a magnet consisting of a barrel of soft iron flaring inwardly at its upper end and a hollow core of soft iron having a flange that fits in said barrel, the core being wound with insulated wire.

574,035. METHOD OF AND MEANS FOR REGULATING ALTERNATING-CURRENT GENERATORS; B. G. Lamme, Pittsburg, Pa. App. filed March 11, 1896. The method of varying the E. M. F. of an alternating-current generator as its load varies, which consists in varying the slip of an alternating-current motor driven by current derived from said generator, and producing a field-magnet exciting or regulating current by the power derived from said motor.

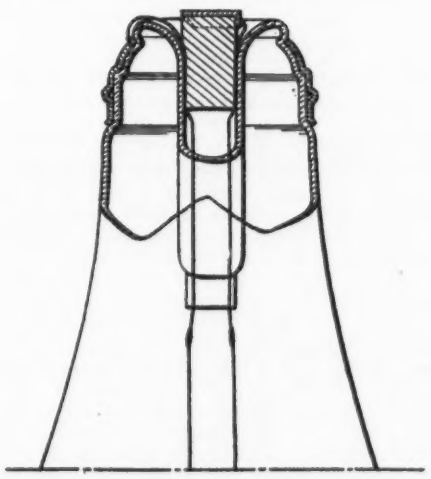
574,045. ELECTRIC ARC LAMP; C. E. Scribner, Chicago, Ill. App. filed May 9, 1893. The combination with two pairs of carbons in an electric circuit, of a differential oscillating magnet in the circuit, a source of permanent magnetic field wherein said magnet is located and mechanism actuated by the said magnet adapted to bring into operation one pair or the other of the carbons, according to the position which said magnet assumes with relation to the said magnetic field when current is sent through it.

574,046. TOLL-BOX FOR TELEPHONES; C. E. Scribner, Chicago, Ill. App. filed May 14, 1896. The combination with the telephone and the telephone line thereof at a toll station, of the toll-box or coin receptacle, an electrically controlled locking device for the toll-box connected with the telephone line, a spring-jack or socket for the line at a central station, and means for connecting therewith a source of electric current to release the said locking mechanism.

574,065. BULB FOR X-RAYS; J. Von Der Kammer, Chicago, Ill. App. filed March 17, 1896. A bulb for the production of so-called X-rays provided with cavities containing respectively the anode and cathode electrodes, the electrodes in said cavities being so arranged that they are presented in substantially the same direction.

574,101. INSULATOR; C. B. Martin, Schenectady, N. Y. App. filed Sept 28, 1896. In an insulator, the combination of a non-rotatable clamp, an insulator provided with a screw thread engaging therewith, and a metal base for the insulator.

574,117. ELECTRIC ARC LAMP; H. A. Seymour. Washington, D. C. App. filed June 30, 1896. In an arc lamp, the combination with its carbons and means for retaining them slightly separated when no current is passing through the lamp, of means for automatically bringing the carbons into contact and means for separating them very slightly when current is sent through the lamp, and means for slowly and gradually separating the non-feeding carbon from the feeding carbon and thereby slowly drawing the arc to any desired length.



573,929.—INCANDESCENT LAMP FITTING.

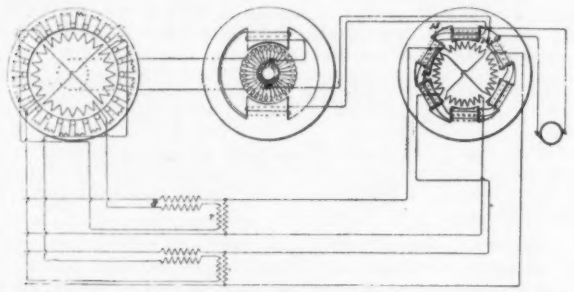
574,118. ELECTRIC ARC LAMP; H. A. Seymour, Washington, D. C. App. filed July 11, 1896. In an arc lamp, the combination with its carbons and means for causing the carbons to become separated by a slow and gradual movement until an arc of normal length has been established, of means for automatically releasing the regulating mechanism from the action of such retarding mechanism and causing the feeding carbon to be sensitively adjusted and fed until consumed.

574,119. ELECTRIC ARC LAMP; H. A. Seymour, Washington, D. C. App. filed July 18, 1896. In an arc lamp, the combination with its carbon and

carbon-holder, of an arc-enclosing globe provided with a cover, which is mounted upon and supported by the carbon-holder.

574,123. ELECTRIC ARC LAMP; E. Thomson, Swampscott, Mass. App filed Aug. 21, 1896. In an electric arc lamp, a pair of solenoids for regulating the lamp, and cores connected by a yoke co-operating with the solenoids, in combination with a clutch comprising a pair of levers connected with the cores by toggle-levers and having portions engaging with the carbon-rod; the whole arranged to increase the grip of the clutch as the cores are drawn upward.

574,171. ELECTRIC RAILWAY; J. A. Roche, Chicago, Ill. App. filed April 13, 1895. The combination with a supply conductor, of a plurality of pivotally-supported insulated conductor-sections, stationary and movable contact pieces, said contact pieces being located at the side of the conductor-sections opposite the pivotal axes of the same, and oscillating arms which are rigidly attached to and move with the conductor-sections, and which carry the movable contact-pieces.



574,035.—Method of and Means for Regulating Alternating Current Generators.

574,215. ELECTROMOTOR MAGNET; C. Partington, Newport, Ky. App filed March 6, 1896. The combination of an electromotor-magnet having operative circuits of greater and lesser resistance, independent terminals for each circuit for changing the circuits through the same helices, an armature pivoted within the magnetic field, lever mechanism actuated by the armature, a cam actuated by said lever mechanism, and a switch operated by said cam to change the currents during the armature movements.

574,217. VOLTAGE REGULATOR FOR DYNAMOS; T. M. Pusey, Kennet, Pa. App. filed May 22, 1896. A voltage regulator for dynamos, comprising a main circuit, a rheostat in a shunt circuit of the dynamo, a helix also comprised in a shunt circuit, a balanced beam operated by said helix and serving as a contact-closer, a rheostat-operating motor, an electrically-operated brake for the armature of said motor, and connections between the said armature and the rheostat for operating said rheostat.

574,221. TELEPHONE EXCHANGE SYSTEM; C. E. Scribner, Chicago, Ill. App. filed June 6, 1894. The combination with a telephone line normally open at a sub-station, provided with a switch adapted to close a circuit through a telephone there, of an annunciator, together with a source of current in the line-circuit at a central station, a connecting plug for making connections with the line, a magnet coil separate from the main coil on the said annunciator, adapted to reset and retain the indicator thereof, the normally open local-circuit connections distinct from the line-circuit, including the said magnet-coil, adapted to be closed when the said connecting plug is inserted into a line spring-jack, a clearing out annunciator adapted to display its indicator upon the cessation of current through it, and circuit connections completed with the said line when connection is made therewith, including said clearing out annunciator.

574,222. SELECTIVE SIGNAL SYSTEM; C. E. Scribner, Chicago, Ill. App. filed Jan. 8, 1895. In a call device, the combination with an electromagnet and an armature polarized by said electromagnet, said magnet having two helices, of a second motor-electromagnet adapted to vibrate said armature when excited by an alternating current, an electric circuit including said motor-electromagnet and divided into branches, including the different helices of said polarizing-magnet, and means for transmitting alternate pulsations of current through the said branches.

574,224. SPRING JACK FOR TELEPHONE SWITCHBOARDS; C. E. Scribner, Chicago, Ill. App. filed June 5, 1894. In a spring jack, the combination with a plate having a tubular channel, a transverse saw-cut and an oblique duct leading from the tubular channel to the saw-cut, of the thimble inserted in the tubular channel, the extension thereof passing through the oblique duct into the saw-cut and twisted at its rear extremity to prevent its withdrawal from the saw-cut.

574,225. SIGNALLING APPARATUS FOR TELEPHONE LINES; C. E. Scribner, Chicago, Ill. App. filed Aug. 17, 1895. In combination with a telephone line, a source of continuous current, permanently connected in the line circuit at a central station, a transformer at the sub-station having one of its helices in the line circuit, a polarized bell at the sub-station in circuit with the other helix of the transformer, a source of alternating current at the central station, and means for connecting it with the telephone line to operate the signal bell.

574,231. CURRENT CONTROLLER OR RHEOSTAT; E. E. Werner, Dallas, Tex. App. filed June 22, 1896. A rheostat consisting of a revoluble cylinder, having upon its periphery a substance adapted to resist an electrical current, composed of black lead and an alcoholic solution of shellac, with a brush adapted to travel laterally along said cylinder and making contact with said resistance, and means for revolving said cylinder and imparting motion to such said brush.

574,245. TELEPHONE SWITCH-BOX; W. A. Houts, S. D. Parker, and L. G. Nilson, Sioux City, Ia. App. filed Aug. 25, 1896. An automatic call for telephones, comprising a casing, an escapement-wheel mounted therein and adapted to make and break an electric circuit, a locking device for said escapement-wheel, a second wheel mounted to rotate relatively to the first-named wheel and carrying a disc having telephone call-numbers thereon, a spring connection between said wheels, a locking device for said last-named wheel, and means for automatically releasing said locking device through the weight of the telephone-receiver.

574,255. TELEPHONE EXCHANGE APPARATUS; F. R. McBerty, Downer's Grove, Ill. App. filed May 25, 1896. In combination, two metallic telephone lines, a ground branch at the different sub-stations from like line-conductors, and a signal-bell in each ground branch, a spring-jack for each line in a switchboard, a double connecting-plug in each spring-jack, unlike contact-pieces of said plugs being connected together, a grounded generator of calling current and means for applying the free pole of said generator to either of the conductors of the plug circuit.

574,278. MOTOR GENERATOR; C. E. Scribner, Chicago, Ill. App. filed June 1, 1889. A motor having a single closed coil armature and a pair of adjustable brushes in a supply-current and a second pair of brushes in combination with a regulator for moving said adjustable brushes responsively to variations in the potential between the different sides of said working circuit to maintain said potential practically constant.

574,279. SIGNALING CIRCUIT FOR TELEPHONE TRUNK LINES; C. E. Scribner, Chicago, Ill. App. filed May 14, 1896. The combination with a circuit having a source of current in it, of two groups of polarization-cells interposed in a conductor of the circuit, and a closed circuit including the said conductor intermediate of the polarization-cells, together with a source of current and a signaling instrument.

574,280. AUTOMATIC SIGNALING-DEVICE FOR TELEPHONE EXCHANGES; C. E. Scribner, Chicago, and F. R. McBerty, Downer's Grove, Ill. App. filed Nov. 27, 1894. In combination, an electromagnet in an electric circuit, together with a source of current and means for closing the circuit, a tongue adapted to be thrown into vibration when the said magnet attracts its armature, switch-contacts actuated by the vibrating tongue to open or close a subsidiary branch or circuit, and an electric bell in the subsidiary branch or circuit.

574,281. PLUG FOR TELEPHONE SWITCHBOARDS; C. E. Scribner, Chicago, and F. R. McBerty, Downer's Grove, Ill. App. filed May 31, 1894. In a connecting plug, the combination with a tube forming or carrying one contact portion of the plug, of a second contact portion surrounding and secured upon a projecting portion of said tube, and a wire extending from said second contact portion through the tube to the interior of the plug.

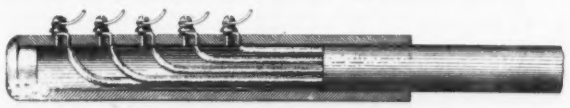
574,301. ELECTRIC LAMP BASE; W. C. Bryant, Bridgeport, Conn. App filed Oct. 31, 1896. A Thomson-Houston incandescent-electric lamp base of porcelain or other such material having a reduced lower end for the reception of a flanged ring-terminal and passages extending from the interior of the hollow base to the reduced end to form lateral openings in the latter, into which the ring-terminal can be indented.

574,320. ELECTRIC WATER WHEEL GOVERNOR; A. Giesler, Dayton, O App. filed April 20, 1896. In a machine for controlling the movement of water wheel gates, the combination with a governor positively driven by the water wheel of two electric circuits, the terminals of which are controlled by said governor, mechanism operated by the circuits for actuating gate-operating mechanism in both directions, and means operated by the governor for quickly breaking the circuits to prevent excessive movement of the gate, and slowly bring back the parts into position for the next operation.

574,322. ELECTRODE FOR SECONDARY VOLTAIC BATTERIES; G. A. Grindle, Prestwitch, England. App. filed Oct. 13, 1896. For filling the holes of an electrode-plate for a secondary voltaic battery, plugs, each consisting of a rolled up strip of lead, having on its side transverse ridges and furrows, all the ridges being connected by a central longitudinal ridge.

574,327. ELECTRICAL ANNUNCIATOR; R. L. Hunter and H. B. Higgins, Minneapolis, Minn. App. filed Nov. 19, 1895. In a bell, the combination with a magnet having its coils in the battery circuit, a gong, its armature connected to said circuit, the hammer carried by said armature, a contact screw connected to said battery circuit on the other side of the magnet, coils from the armature connection, and carbon contacts interposed betweeen the armature and screw.

574,333. MECHANISM FOR LOCATING AND DETERMINING DEFECTS IN RAIL BONDING; P. O. Keilholtz, Baltimore, Md. App. filed Feb. 20, 1896. A device comprising a series of contacts connected in pairs through potential indicating or recording instruments and electrical conductors each pair of contacts being arranged to make sliding or rubbing contact at simultaneously-corresponding points of a separate conductor.



574,343.—Terminal for Electric Cables.

574,343. TERMINAL FOR ELECTRIC CABLES; E. S. Reid, New York, N. Y. App. filed March 29, 1892. A terminal for electric cables consisting of a case or shell formed in two longitudinal sections, and means for securing said sections together around a cable, the sections being made of substantially uniform cross-sectional shape throughout their entire length, and of such internal dimensions as to form a tight joint with the covering of the cable when applied thereto.

574,345. TROLLEY; N. D. Stanley and J. S. Reynolds, Essex, Vt. App. filed April 16, 1896. The combination with the trolley pole and main wheel of a vertically-swinging yoke depending from the spindle or axis of said wheel, an arm secured to the lower end of the yoke and having an auxiliary or rear trolley wheel, and a spring pressing the yoke rearwardly and upwardly to hold its wheel to the wire.